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NATIONAL DAM SAFETY PROGRAM. MARTIN DUNHAM RESERVOIR DAM (INVEN--ETC(U)
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LEVEL II

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LOWER HUDSON RIVER BASIN

MARTIN DUNHAM RESERVOIR DAM

RENSSELAER COUNTY, NEW YORK

AD A105839

INVENTORY NO. N.Y. 672

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

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NEW YORK DISTRICT CORPS OF ENGINEERS

APRIL, 1981

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Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and a visual inspection of this dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which need to be evaluated and remedied.

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The most serious deficiency noted was a large wet area near the right abutment contact at the downstream toe of the main embankment. The ground in this area was very soft and there was minor sloughing of the embankment slope, as well. Two smaller wet areas were also observed. One of these was near the downstream toe at the left end of the main embankment and the other was beyond the toe of the spillway dike. Investigations into the causes and possible treatments of these wet areas should be commenced within 3 months of the date of notification of the owner. Remedial measures on these areas should be completed within 12 months.

The hydrologic/hydraulic analysis performed indicates that the spillway does not have sufficient capacity to discharge the peak outflow from one-half the Probable Maximum Flood (PMF). However, spillway discharges occurring during large storm events will cause water surface elevations in the downstream hazard area to rise to flood levels. A dam failure resulting from overtopping would not significantly increase the hazard to loss of life from that which would exist just prior to an overtopping failure. Therefore, the spillway is assessed as inadequate.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MARTIN DUNHAM RESERVOIR DAM
I.D. No. NY 762
24C-1430
LOWER HUDSON RIVER BASIN
RENSSELAER COUNTY, NEW YORK

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Martin Dunham Reservoir Dam (I.D. No. NY 672)
State Located:	New York
County:	Rensselaer
Watershed:	Lower Hudson River Basin
Stream:	Quacken Kill
Date of Inspection:	November 13, 1980

ASSESSMENT

Examination of available documents and a visual inspection of this dam did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which need to be evaluated and remedied.

The most serious deficiency noted was a large wet area near the right abutment contact at the downstream toe of the main embankment. The ground in this area was very soft and there was minor sloughing of the embankment slope, as well. Two smaller wet areas were also observed. One of these was near the downstream toe at the left end of the main embankment and the other was beyond the toe of the spillway dike. Investigations into the causes and possible treatments of these wet areas should be commenced within 3 months of the date of notification of the owner. Remedial measures on these areas should be completed within 12 months.

The hydrologic/hydraulic analysis performed indicates that the spillway does not have sufficient capacity to discharge the peak outflow from one-half the Probable Maximum Flood (PMF). However, spillway discharges occurring during large storm events will cause water surface elevations in the downstream hazard area to rise to flood levels. A dam failure resulting from overtopping would not significantly increase the hazard to loss of life from that which would exist just prior to an overtopping failure. Therefore, the spillway is assessed as inadequate.

A number of other deficiencies were noted on this structure. These deficiencies should be corrected within 12 months of the date of notification of the owner. Among the required actions are the following:

1. Cut brush and trees growing on both main embankment and spillway dike.

2. Repair cracks and spalling concrete at both ends of spillway section.

3. Replace backfill along left spillway wingwall.

4. Repair deteriorated concrete slabs forming the spillway apron;

5. Cut trees growing in channel immediately downstream of spillway;

6. Make valves at mid-point of the two 24 inch low level outlet pipes operational.

7. Develop an emergency action plan for the notification and evacuation of downstream residents.

George Koch
Chief, Dam Safety Section
New York State Department
of Environmental Conservation
NY License No. 45937

Approved By:

for Deputy DE
Col. W. M. Smith, Jr.
New York District Engineer

Date: 14 MAY 1981

OVERVIEW - MAIN EMBANKMENT
MARTIN - DUNHAM RESERVOIR

OVERVIEW - SPILLWAY DIKE

PHASE I INSPECTION REPORT
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SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority
The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection
This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam
The Martin Dunham Reservoir Dam is an earth dam consisting of a main embankment and a separate dike section. There is an Ambursen-type concrete spillway section near the north end of the dike. Two low level outlet conduits pass through the main embankment and there is one pipe through the dike section.

The main embankment is 660 feet long and a maximum of 84 feet high. The crest width is 20 feet. The upstream slope of the embankment is 1 vertical on 2.5 horizontal. The downstream slope is 1 vertical on 2 horizontal. There are two thin concrete core walls which extend the length of the embankment.

The dike is approximately 400 feet to the east of the main embankment. It is 555 feet long and a maximum of 22 feet high. The crest is 12 feet wide. Both the upstream and downstream slopes of this section are 1 vertical on 2.5 horizontal. There is a concrete core wall which extends within the entire embankment. The spillway divides this dike into two segments.

The spillway is a 100 foot long ungated concrete overflow weir. It is located across the original stream channel of Shaver Pond Brook. There are concrete slabs forming an apron at the downstream toe of the spillway section. These slabs and rip rap in the downstream channel provide erosion protection.

Two 24 inch diameter cast iron pipes pass through the main embankment. These pipes serve as low level outlets and can also act as reservoir drains. The pipes are each 275 feet long. Flow through these pipes is controlled by valves at the outlet end. These valves are housed in a concrete gate chamber at the downstream toe of the dam. There are also valves near the mid-point of these pipes. The control mechanism for these valves is located in a brick gate house situated on the crest of the dam.

Plans indicate that there are two anti-seepage cutoff walls on the upstream portion of these pipes. There is also a 20 foot high concrete riser at the upstream end of one of the pipes. However, since the crest of this riser is almost 50 feet below the normal water surface, it does not control flow through the pipe.

There is a 12 inch diameter cast iron pipe located in the dike section. This pipe may serve as a low level outlet. This pipe is 95 feet long and has two concrete cutoff walls to prevent seepage along the pipe. There is a valve located beneath the crest of the dike which controls flow in this pipe. The control mechanism for this valve is located in a manhole with access from the top of the dam.

b. Location

The Martin Dunham Reservoir Dam is located off Reservoir Road in the Town of Grafton. It is about 1/2 mile south of New York State Route 2 and 2 miles southwest of the Village of Grafton. The structure is located within the Grafton Lakes State Park.

c. Size Classification

The dam is a maximum of 84 feet high and has a storage capacity of 2322 acre feet. Therefore, the dam is in the intermediate size category as defined by the "Recommended Guidelines for Safety Inspection of Dams".

d. Hazard Classification

The dam is classified as "high" hazard due to the presence of a group of homes located adjacent to the stream bed in the hamlet of Quackenkill, about 3.5 miles downstream of the dam.

e. Ownership

The dam is owned by New York State Office of Parks and Recreation. It is located within the Saratoga-Capital District State Park Region, whose headquarters are in Saratoga. Those contacted concerning the inspection are as follows:

Mr. Jack Barkevich Associate Park Engineer Office of Parks and Recreation Agency Building No. 1 Empire State Plaza Albany, NY 12238 (518) 474-0482	Mr. Sam MacMillan Park Engineer Grafton Lakes State Park Grafton, NY (518) 279-1155

f. Purpose of Dam

The dam was constructed for the City of Troy, NY to create a water supply reservoir. New York State Office of Parks and Recreation took over control of this dam in about 1965. The reservoir is now used for recreational purposes.

g. Design and Construction History

This dam was constructed in 1912 for the City of Troy. Plans and construction specifications were prepared in 1911 under the direction of the Commissioner of Public Works for Troy. The dam was built by the Otis Construction Company, who took a sub-letting of the contract from the McDonough Construction Company of Troy.

h. Normal Operation Procedures

There are no regular operation procedures on this structure. A continuous discharge through the low level outlets is provided for fish habitation in the downstream channel.

1.3 PERTINENT DATA

a. Drainage Area (sq. mi.)	11.64
b. Discharge At Dam (cfs)	
Concrete spillway - Water Surface at Top of Dam	4556
Low level outlet pipes:	
2-24 inch pipes - water surface at spillway crest	132
12 inch pipe-water surface at spillway crest	7
c. Elevation (Plan Datum)	
Top of Dam	107.0
Top of Dike	106.0
Spillway Crest	100.0
Inlet Invert of 12 inch low level outlet pipe	92.0
Inlet Invert of 2-24 inch low level outlet pipes	53.8
d. Reservoir (Surface Area) (acres)	
Top of Dam	123.5
Spillway Crest	98.5
e. Storage Capacity (acre-feet)	
Top of Dam	2322
Spillway Crest	1648

f. Dam

Type: Compacted earth embankment with two thin concrete core walls.

Embankment Length (ft)	660
Slopes (V:H) Upstream	1 on 2 1/2
Downstream	1 on 2
Crest Width (ft)	20

g. Dike

Type: Compacted earth embankment with concrete core wall

Embankment Length (ft)	400
Slopes (V:H) Upstream	1 on 2 1/2
Downstream	1 on 2 1/2
Crest Width (ft)	12

h. Spillway

Type: Ambursen-type concrete overflow weir inclined upstream slab and hollow interior

Length of Weir (ft)	100

i. Low Level Outlets

1) 2-24 Inch Pipes - Cast iron pipes through main embankment, 275 feet long; Valves controlling flow both at outlet end and at midpoint of pipes; May also act as reservoir drain.

2) 12 inch -Cast iron pipe through dike section 95 feet long; Valve beneath crest of dam near midpoint of pipe.

SECTION 2: ENGINEERING DATA

2.1 GEOTECHNICAL DATA

a. Geology

The Martin Dunham Reservoir Dam is located in the Taconic Section of the New England Uplands physiographic province of New York State. The bedrock in this province consists of limestones, sandstones and slates. They have been altered and broken by the folding and faulting which has characterized the geologic history of these areas. A review of the "Brittle Structures Map of the State of New York" indicated that there are no faults in the vicinity of this dam.

Surficial soils in the area are the results of glaciations during the Cenozoic Era, the last of which was the Wisconsin glaciation.

b. Subsurface investigation

A subsurface investigation program was performed for this structure during the original design. The results of ten drill holes progressed in the area of the main embankment are shown on the plans. These borings indicate that the foundation consists of thin deposits of sand and glacial till over bedrock. Bedrock varied in depth from 30 feet at the left end of the section to 5 feet at the right end.

2.2 DESIGN RECORDS

Plans and construction specifications were prepared in 1911 under the direction of the Commissioner of Public Works for the City of Troy. These were the only design records available.

2.3 CONSTRUCTION RECORDS

This dam was constructed in 1912 by the Otis Construction Company. There was some correspondence available concerning the construction. Conservation Commission representatives inspected the structure several times during construction. The most significant change in the original design was that the concrete spillway section was changed from a mass concrete structure to an Ambursen-type (hollow interior) structure.

2.4 OPERATION RECORDS

No operation records were available for this structure.

2.5 EVALUATION OF DATA

Information used for the preparation of this report was obtained from the Department of Environmental Conservation files and from the City of Troy's Department of Public Utilities files. The information available appeared to be reasonably accurate.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General

Visual inspection of the Martin Dunham Reservoir Dam was conducted on November 13, 1980. The weather was sunny with the temperature around 40 degrees. The water level at the time of the inspection was slightly above the crest of the spillway.

b. Main Embankment

Inspection of the main embankment was hampered by the trees and brush growing on the downstream face. There was also a dense cover of brush on the upstream face. The crest was grassed but somewhat irregular. There were several uprooted trees on the upper portion of the downstream slope.

Two wet areas were noted on the downstream slope. Both areas were near the downstream toe. One area was at the left end of the dam and was relatively minor in nature. The other wet area was along the right abutment contact. Seepage appeared about half way up the abutment and covered an extensive area which extended down to the base of the embankment. The ground in the area was very soft and some minor sloughing of the embankment slope was also noted.

c. Dike

The earth dike was also covered with brush and trees. Inspection of this dike was hampered by the vegetated growth. There was a wet area beyond the downstream toe near the point where the embankment takes a 90 degree bend. No concentrated seepage was noted in this area but the ground surface was soft and spongy. Another deficiency noted on this segment was an area adjacent to the left spillway wingwall where the backfill had been removed. This was probably due to scouring during high flows.

d. Spillway

The spillway was in satisfactory condition. Some concrete surface deterioration was noted on the spillway crest, but there were no large voids or cracks visible. Inspection of the underside of the concrete slab revealed that this concrete was in good condition. The buttresses supporting the crest concrete were also in good condition. There were several large cracks extending for the entire height of the right abutment wall. One area extended along the entire downstream inclined section. There was also extensive deterioration along the lower half of the upstream inclined section. The slabs which form an apron downstream from the spillway were in varying stages of deterioration. Some of the slabs were intact while others were almost completely removed.

e. Low Level Outlet Pipes

Only a limited inspection of the low level outlet pipes was possible due to the nature of these facilities. The two 24 inch pipes through the main embankment were used to provide normal flows in the downstream channel. The valves located near the midpoint of these pipes (beneath the crest of the dam) were open but inoperable. Flow through the pipes was controlled by valves at the outlet end. These valves were refurbished recently and the concrete valve chamber was reconstructed. These valves

were operational. One of the valves was partially opened at the time of the inspection. Controlling flow at the outlet end of the pipes is undesirable since it results in the conduit always being subjected to pressure. There was surficial rusting on the pipes and the flap covers which are at the end of each pipe.

The 12 inch pipe through the spillway dike did not appear to be operational. The valve controlling flow through this pipe was located in a manhole on the crest of the dike. It appeared that there had been no flow through this pipe for a long period of time.

f. Reservoir

There were no indications of soil instability in the reservoir area.

g. Downstream Channel

The channel downstream of the spillway was natural and rock filled. There were a number of trees growing in the channel immediately downstream of the spillway apron.

3.2 EVALUATION OF OBSERVATIONS

Visual observations revealed several deficiencies on this structure. The following items were noted:

1. A large wet area at the downstream toe of the main embankment along the right abutment contact.
2. A smaller wet area on the left end of the main embankment.
3. An area downstream of the spillway dike in which the ground was soft and spongy.
4. Brush and trees growing on both the main embankment and the spillway dike.
5. Several uprooted trees on the crest of the main embankment.
6. Removed backfill along the left spillway wingwall.
7. Cracks and spalling concrete on the wingwalls at both ends of the spillway.
8. Deterioration of the concrete on the slabs which form the spillway apron.
9. Trees growing in the channel immediately downstream of the spillway apron.
10. The valves near the middle of the two 24 inch low level outlet pipes being under pressure at all times.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no formal operating procedures for this dam. The low level outlet pipes remain partially opened to provide flows downstream for the fish population.

4.2 MAINTENANCE OF DAM

There is no established maintenance plan for this dam.

4.3 WARNING SYSTEM IN EFFECT

No apparent warning system for evacuation of downstream residents is present.

4.4 EVALUATION

The operation procedures on this structure are satisfactory. Increased maintenance efforts are required to correct the deficiencies noted in section 3.2.

SECTION 5: HYDROLOGIC/HYDRAULIC

5.1 DRAINAGE AREA CHARACTERISTICS

The delineation of the contributing watershed to this dam is indicated on the map titled "Drainage Area Map - Martin Dunham Reservoir" (Appendix C). The irregular but somewhat rectangular-shaped, east-west oriented watershed of some 11.64 square miles (7452 acres) is comprised of relatively undeveloped lands consisting of open fields, woodlands, and forests. The hamlet of Grafton located near the center of the watershed is the largest developed area. Slopes along the primary drainage paths are flat (less than 3.5%). However, the adjacent hillsides have moderate slopes (less than 8%); with those hills forming the watershed divide ranging from 200 feet to 500 feet in elevation above the reservoir. Numerous bodies of water within the watershed are Cranberry Pond, White Lily Pond, and Lake Elizabeth located within subasin one, Shaver located in subbasin two, and Long Pond, Second Pond, and Mill Pond, all situated in the Grafton Lakes State Park, located in subbasin three. The above four ponds located in subbasins two and three also have dams regulating outlet stream discharges although these structures were not considered in the watershed analysis because of their small size. Also interspersed throughout the watershed are several sizable wetlands. The two major tributaries, Shaver Pond Brook and the Quacken Kill join within the reservoir. The outlet stream is known as the Quacken Kill.

5.2 ANALYSIS CRITERIA

No hydrologic/hydraulic information was available regarding the original design for this dam. Therefore, the analysis of the floodwater retarding capability of the dam was performed using the Corps of Engineers HEC-1 computer program, Dam Safety version. The computer program develops inflow hydrographs using the "Snyder Unit Hydrograph" method for each of the subbasins, combines them at selected stream locations, and then reservoir routs the resulting hydrograph using the "Modified Puls" flood routing procedure. The spillway design flood selected for analysis was the Probable Maximum Flood (PMF), in accordance with the Recommended Guidelines of the U.S. Army Corps of Engineers. The PMF event is that hypothetical storm event resulting from the most critical combination of rainfall, minimum soil retention, and direct runoff to a specific site that is considered reasonably possible for a particular watershed. Precipitation values used in the analysis were obtained from the Weather Bureau publication HRR 33.

5.3 SPILLWAY CAPACITY

The single, 100 foot long, ungated Ambursen spillway was analyzed for weir flow using a discharge coefficient, C, of 3.1. The computed discharge capacity of the spillway is 4556 cfs.

The flood analysis performed for this dam indicates that the spillway does not have sufficient capacity for discharging one-half the PMF. For this storm event, the peak inflow is 6878 cfs and the peak outflow is 6822 cfs. The PMF peak inflow and peak outflow are 13, 755 cfs and 13,656 cfs respectively.

5.4 RESERVOIR CAPACITY

The normal water surface is at or near the spillway crest elevation of 100.0 (plan datum). Using the 1911 reservoir contour mapping for the project, the impounded capacity at this elevation is 1648 acre-feet. Surcharge storage capacity to the top-of-dam (elev. 106) adds 674 acre-feet which is equivalent to a direct runoff depth of 1.08 inches over the watershed. The total storage capacity is 2322 acre-feet.

5.5 FLOODS OF RECORD

The date of occurrence of the maximum flood at the dam site is not known.

5.6 OVERTOPPING POTENTIAL

Analyses using the PMF and one-half the PMF storm events indicates that the spillway does not have sufficient discharge capacity. The computed depths of overtopping for these two events are 1.81 feet and 0.66 feet respectively. All storm events exceeding 36% of the PMF will result in the dam being overtopped.

5.7 EVALUATION

Overtopping the earth embankment and dike is likely to cause dam failure. The spillway capacity is inadequate for the peak outflow from one-half the PMF.

Spillway discharges flow downstream in the relatively narrow and confining channel for some 3.5 miles to the settlement at Quacken Kill, and then an additional 2 miles to Cropseyville. Between Quacken Kill and Cropseyville, numerous residences as well as State Route 2 are located immediately adjacent the stream channel. For increased spillway discharges occurring during large storm events, downstream water surface elevations would rise to flood levels exceeding the top-of-streambank elevations. Therefore, a dam failure resulting from overtopping would not significantly increase the hazard to loss of life downstream from that which would exist just prior to an overtopping failure. The spillway is, therefore, assessed as inadequate.

SECTION 6: STRUCTURAL STABILITY

6. 1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

inspection

Visual inspection of the embankments was hampered by trees and brush growing on the slopes. No major settlement or sloughing of the embankment was noted. There were several wet areas observed at the downstream toe of the embankments. The most extensive of these was along the right abutment of the main embankment. The ground in this area was extremely soft and minor sloughing was noted at the toe of the embankment. The other wet areas were near the downstream toe at the left end of the main embankment and near the 90 degree bend in the spillway dike.

b. Data Review and Stability Evaluation

No design information concerning the stability of either the earth embankment sections or the concrete spillway section was available. The construction plans provided a cross section of the spillway. The design of the spillway section was changed during construction from a mass concrete section to an Ambursen - type (hollow interior)structure.

A stability analysis was performed for this report in accordance with the "Recommended Guidelines for Safety Inspection of Dams". Due to the sloping upstream face of the spillway section, it was assumed that an expanding ice sheet would deflect up on the structure. Therefore, no ice loading was considered in the analyses. For the purposes of the analyses, it was assumed that the combination of cutoff walls at both the upstream and downstream ends of the spillway and weep holes in the base were effective in reducing uplift pressures.

Appendix D

The results of the analyses performed (See Appendix D) are as follows:

Case	Overturning Safety Factor	Resultant In Middle Third	Sliding Safety Factor
a. Normal conditions; water surface at spillway crest	2.26	YES	1.80
b. Flood flows; water surface a top of spillway dike	1.18	NO	1.06
c. Normal conditions with seismic co-efficient of 0.10	2.06	YES	1.44

The analyses performed indicate that under normal conditions the structure has an adequate safety factor against overturning. While the sliding safety factor for these conditions is below the recommended value, it is considered adequate as well. For extreme loading conditions, such as flood flows, the dam is marginally stable. However, as discussed in Section 5.7, spillway discharges under these flow conditions would cause flooding downstream even if the spillway did not fail. Therefore, no further stability investigations are required.

c. Seismic Stability

The structure is located in Seismic Zone 2. A Seismic stability analysis was performed assuming a seismic coefficient of 0.1. The results of this analysis (shown on page 10) indicate that the safety factors are adequate when seismic considerations are included.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety
The Phase I inspection of the Martin Dunham Reservoir Dam revealed a large wet area near the downstream toe along the right abutment contact on the main embankment. The ground was very soft in this area and there was minor sloughing of the embankment slope. Two other smaller wet areas were also noted beyond the downstream of the embankment. Both the main embankment and the spillway dike were covered with trees and brush. Several uprooted trees were noted along the crest of the main embankment.

The spillway capacity is inadequate for the peak outflow from one-half the Probable Maximum Flood (PMF). However, since downstream flooding could be expected prior to an overtopping induced failure, the spillway capacity is not considered to be seriously inadequate.

b. Adequacy of Information
The information available for the preparation of this report was fairly complete and appeared to be reasonably accurate.

c. Need for Additional Investigations
Investigations into the causes of the wet areas downstream of the dam and into possible treatments for these wet areas are required. Priority should be given to devising a method of treatment for the large wet area at the right abutment contact.

d. Urgency
The investigations into the wet area should be commenced within 3 months of the date of notification of the owner. Remedial measures deemed appropriate as a result of the investigations should be completed within 12 months.

Other deficiencies outlined below should also be corrected within 12 months of the date of notification of the owner.

7.2 RECOMMENDED MEASURES

a. A method of treatment of the wet areas at the downstream toe should be designed and implemented.

b. Brush and trees growing on both the main embankment and on the spillway dike should be cut.

c. Areas on the main embankment where trees have been uprooted should be regraded and seeded.

d. Cracks and spalling concrete on wingwalls at both ends of the spillway should be repaired.

e. Removed backfill along the left spillway wingwall should be replaced.

f. Deterioriated concrete slabs forming the spillway apron should be repaired.

g. Trees growing in the channel immediately downstream of the spillway apron should be cut.

APPENDIX A

PHOTOGRAPHS

MAIN EMBANKMENT - SEPTEMBER 1914

MAIN EMBANKMENT - NOVEMBER 1980

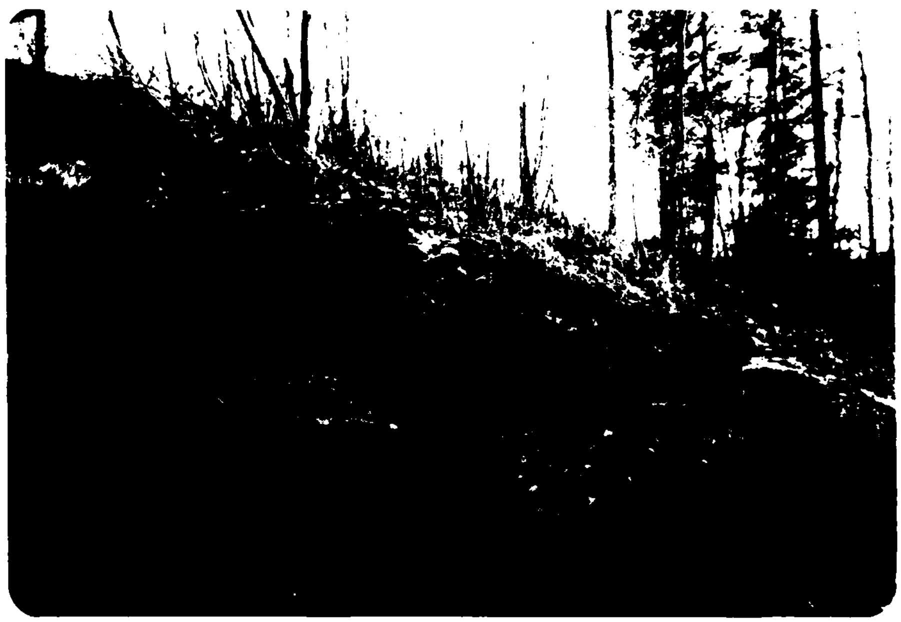
DOWNSTREAM SLOPE OF MAIN EMBANKMENT

UPROOTED TREE ON DOWNSTREAM SLOPE
(ONE OF SEVERAL)

SEEPAGE AREA @ TOE OF MAIN EMBANKMENT

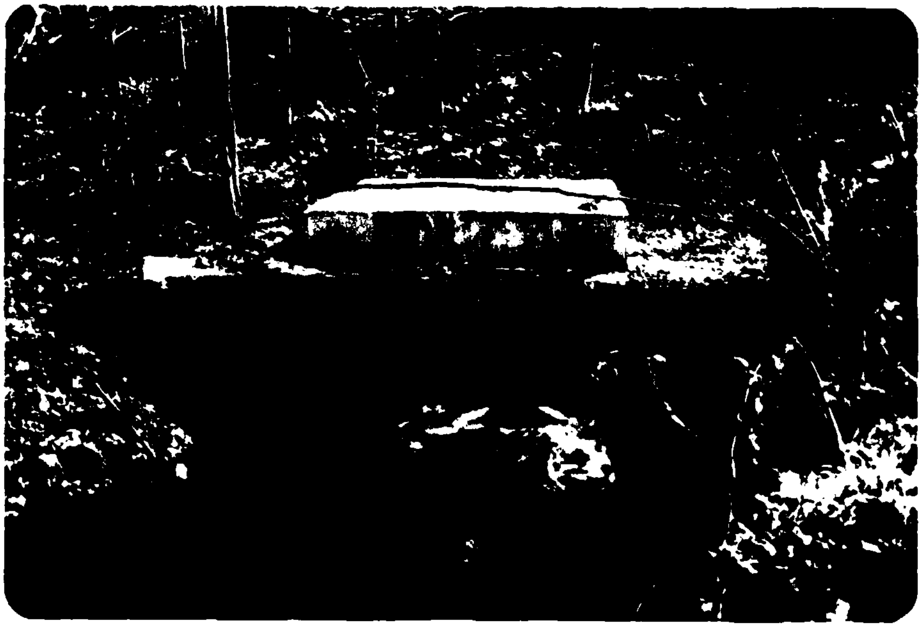
SEEPAGE AREA (as above)

SPILLWAY @ MARTIN - DUNHAM RESERVOIR



CONCRETE DETERIORATION @ SPILLWAY LEFT WALL

SPILLWAY DIKE - OUTLET STRUCTURE FOR 12" PIPE



MAIN EMBANKMENT - OUTLET STRUCTURE FOR TWIN
24" PIPES (RESERVOIR DRAIN)

APPENDIX B

VISUAL INSPECTION CHECKLIST

93-15-3(9/80)

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam MARTIN DUNHAM RESERVOIR DAM

Fed. I.D. # NY 672 DEC Dam No. 243C- 1430

River Basin LOWER HUDSON

Location: Town GRAFTON County RENSSELAER

Stream Name QUACKEN KILL

Tributary of BATTENKILL

Latitude (N) 42° 45.1' Longitude (W) 73° 29.1'

Type of Dam EARTH WITH CONCRETE CORE WALL

Hazard Category HIGH HAZARD

Date(s) of Inspection 11/13/80

Weather Conditions SUNNY - 40°

Reservoir Level at Time of Inspection SLIGHTLY ABOVE SPILLCREST

b. Inspection Personnel ROBIN WARRENDER, WALTER LYNICK

c. Persons Contacted (Including Address & Phone No.)

ED BLY - CAPITAL DISTRICT STATE PARK COMMISSION
GRAFTON LAKES STATE PARK
GRAFTON, N.Y.
518-279-1155

d. History:

Date Constructed 1912 Date(s) Reconstructed

Designer CITY OF TROY DEPT. OF PUBLIC WORKS

Constructed By OTIS CONSTRUCTION Co.

Owner NYS OFFICE OF PARKS & RECREATION

93-15-3(9/80)

2) Embankment – MAIN EMBANKMENT SECTION

a. Characteristics

(1) Embankment Material GLACIAL TILL

(2) Cutoff Type NONE

(3) Impervious Core CONCRETE CORE WALL

(4) Internal Drainage System NONE

(5) Miscellaneous

b. Crest

(1) Vertical Alignment IRREGULAR WITH WHEEL PATHS OR GULLIES

(2) Horizontal Alignment SATISFACTORY

(3) Surface Cracks NONE

(4) Miscellaneous NONE

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1 ON 2½

(2) Undesirable Growth or Debris, Animal Burrows BRUSH THROUGH RIPRAP ON FACE

(3) Sloughing, Subsidence or Depressions NONE

(4) Slope Protection RIP RAP

(5) Surface Cracks or Movement at Toe UNOBSERVABLE

d. Downstream Slope

(1) Slope (Estimate - V:H) 1 ON 2

(2) Undesirable Growth or Debris, Animal Burrows LARGE TREES & BRUSH ON ENTIRE FACE - SOME BLOWN DOWN TREES NEAR CREST

(3) Sloughing, Subsidence or Depressions NONE

(4) Surface Cracks or Movement at Toe SOME MINOR SLOUGHING NEAR RIGHT ABUTMENT IN WET AREA

(5) Seepage LARGE WET AREA ALONG RIGHT ABUTMENT AT DOWNSTREAM TOE - SMALLER WET AREA AT D.S. TOE OF LEFT END OF DAM

(6) External Drainage System (Ditches, Trenches; Blanket) NONE

(7) Condition Around Outlet Structure SATISFACTORY

(8) Seepage Beyond Toe NONE EXCEPT AS NOTED ABOVE

e. Abutments - Embankment Contact

BOTH EMBANKMENTS - SATISFACTORY EXCEPT FOR SEEPAGE NOTED ABOVE

93-15-3(9/80) MAIN EMBANKMENT SECTION

(1) Erosion at Contact NONE

(2) Seepage Along Contact - ALONG RIGHT ABUTMENT WATER FLOWING FROM ABOUT 30' UP FROM THE TOE SOIL VERY SOFT - SLOUGHING ON EMBANKMENT SLOPE.

3) Drainage System

a. Description of System

NONE

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

NONE

2) Embankment - DIKE SECTION

a. Characteristics

(1) Embankment Material GLACIAL TILL

(2) Cutoff Type CONCRETE CORE WALL TO ROCK

(3) Impervious Core CONCRETE CORE WALL

(4) Internal Drainage System NONE

(5) Miscellaneous

b. Crest

(1) Vertical Alignment SATISFACTORY

(2) Horizontal Alignment SATISFACTORY

(3) Surface Cracks NONE

(4) Miscellaneous BRUSH & TREES GROWING ON CREST

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1 ON 2½

(2) Undesirable Growth or Debris, Animal Burrows TREES & BRUSH

(3) Sloughing, Subsidence or Depressions NONE

DIKE SECTION

(4) Slope Protection RIPRAP

(5) Surface Cracks or Movement at Toe

d. Downstream Slope

(1) Slope (Estimate - V:H) 1 ON 2½

(2) Undesirable Growth or Debris, Animal Burrows BRUSH & TREES

(3) Sloughing, Subsidence or Depressions NONE ON MOST OF DIKE SOME MISSING BACKFILL 6"

(4) Surface Cracks or Movement at Toe NONE

(5) Seepage ONE WET AREA NOTED BEYOND TOE

(6) External Drainage System (Ditches, Trenches; Blanket) NONE

(7) Condition Around Outlet Structure SATISFACTORY

(8) Seepage Beyond Toe WET AREA NOTED NEAR 90° BEND IN SPILLWAY DIKE - GROUND SOMEWHAT SOFT

e. Abutments - Embankment Contact SATISFACTORY - VERY FLAT CONTACTS

93-15-3(9/80)

5) Reservoir

a. Slopes SATISFACTORY

b. Sedimentation NONE NOTED

c. Unusual Conditions Which Affect Dam ~~NONE~~ LARGE AREA OF TREES & BRUSH NEAR RIGHT 1/3 OF SPILLWAY ENTRANCE WITHIN 50 ft. FLOW RESTRICTION POSSIBLE

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) ± 3.5 MILES TO HAMLET OF QUACKENKILL AT ROUTE 2 BRIDGE CROSSING

b. Seepage, Unusual Growth NONE - EXCEPT AS PREVIOUSLY NOTED

c. Evidence of Movement Beyond Toe of Dam NO

d. Condition of Downstream Channel NATURAL BOULDER STREWN CHANNEL. CONFINED, STEEP SIDED ALL THE WAY TO CROPSEYVILLE

7) Spillway(s) (Including Discharge Conveyance Channel)

LOW HEIGHT AMBURSEN TYPE CONCRETE SPILLWAY

a. General CONCRETE ON UNDERSIDE OF SPILLWAY SECTION & ON CONCRETE BUTRESSES IN GOOD CONDITION - CONCRETE ON SPILLWAY CREST HAS SOME SURFACE DETERIORATION DUE TO FLOWING WATER - NO LARGE CRACKS OR VOIDS

~~b. Condition of Service Spillway~~ VISIBLE ABUTMENT WING WALLS - RT. ABUT. - SEVERAL LARGE CRACKS EXTENDING ENTIRE HEIGHT OF WALL; MINOR SPALLING LEFT ABUTMENT - LARGE AREA OF SPALLING & DETERIORATION ALSO 1/2 LENGTH OF ENTIRE UPSTREAM INCLINED SECTION.

b. Condition of Auxiliary Spillway NONE

c. APRON - CONCRETE SLAB APRON EXTENDS 20' FROM DOWNSTREAM TOE. SLABS IN VARIOUS STAGES OF DETERIORATION - SOME INTACT SOME ALMOST ENTIRELY GONE

d. Condition of Discharge Conveyance Channel BOULDER STREWN CHANNEL WITH LARGE TREES GROWING BEYOND END OF CONCRETE SLAB APRON - SHOULD CLEAR AREA FOR AT LEAST 100' DOWNSTREAM OF DAM.

8) ~~Reservoir Drain~~ LOW LEVEL/Outlet - 2 PIPES IN MAIN EMBANKMENT SECTION

Type: Pipe √ (2) Conduit ______ Other ______

Material: Concrete ______ Metal CAST IRON Other ______

Size: 24 IN. DIA Length ______

Invert Elevations: Entrance 53.8 Exit 49

Physical Condition (Describe): Unobservable √

Material: ______

Joints: ______ Alignment ______

Structural Integrity: ______

Hydraulic Capability: EACH HAS FLAP COVER AT OUTLET REDUCING CAPACITY

Means of Control: Gate √ Valve ______ Uncontrolled ______

Operation: Operable √ Inoperable ______ Other ______

Present Condition (Describe): GATES AT MID POINT OF PIPE ARE OPEN BUT INOPERABLE - GATES AT OUTLET END OPERABLE - CONDUIT ALWAYS UNDER PRESSURE - NEW GATE HOUSE AT TOE IS LOCKED

c. ~~Condition of Auxiliary Spillway~~ ______

d. ~~Condition of Discharge Conveyance Channel~~ ______

8) Reservoir Drain/Outlet - PIPE THROUGH DIKE SECTION

Type: Pipe V Conduit ______ Other ______

Material: Concrete ______ Metal CAST IRON Other ______

Size: 12" DIA Length 80'

Invert Elevations: Entrance 92 Exit 91.5

Physical Condition (Describe): Unobservable V

Material: ______

Joints: ______ Alignment ______

Structural Integrity: ______

Hydraulic Capability: FLAP GATE ON OUTLET

Means of Control: Gate V Valve ______ Uncontrolled ______

Operation: Operable ______ Inoperable V Other ______

Present Condition (Describe): DOES NOT APPEAR TO HAVE BEEN OPERATED FOR A LONG TIME

SECTION 10 - APPORTENANT STRUCTURES & SECTION 11 - OPERATION PROCEDURES } NOT COMPLETED NOT APPLICABLE

SECTION 9 - STURUCTURAL - DISCUSSED IN OTHER SECTIONS

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

MARTIN - DUNHAM RESERVOIR
NY-672

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	(PLAN) Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam (DIKE)	106	123.5	2322
2) Design High Water (Max. Design Pool)	N/A		
3) Auxiliary Spillway Crest	N/A		
4) Pool Level with Flashboards	N/A		
5) Service Spillway Crest	100	98.5	1648

DISCHARGES

	[redacted] (cfs)
1) Average Daily	N/A
2) Spillway @ Maximum High Water	4556
3) Spillway @ Design High Water	N/A
4) Spillway @ Auxiliary Spillway Crest Elevation	N/A
5) Low Level Outlet (2 - 24"ϕ PIPES) [W.S. @ EL. 100]	132 (MAX)
6) Total (of all facilities) @ Maximum High Water [INCL. 2-24"ϕ + 1-12"ϕ]	4695
7) Maximum Known Flood	N/A
8) At Time of Inspection	±5

MARTIN - DUNHAM RESV.
NY-672

DIKE
CREST: (PLAN) ELEVATION: 106

Type: BROAD-CRESTED; EARTH W/ VEGETATIVE COVER

Width: 12' Length: MAIN EMB = 660' / SPILLWAY DIKE = 450' } 1110'

Spillover Location: @ RIGHT END OF SPILLWAY DIKE - SERVICE SPILLWAY

SPILLWAY:

SERVICE		AUXILIARY
100.0	(PLAN) Elevation	—
UNGATED WEIR (AMBURSEN W/ VERT. DNSTRM. FACE)	Type	NONE
3.4'	Width	

Type of Control

✓	Uncontrolled	
	Controlled:	
N/A	Type (Flashboards; gate)	
—	Number	
100'	[redacted]/Length	
	Invert Material	
	Anticipated Length of operating service	
N/A	Chute Length	
SLOPING UPSTREAM FACE	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : NONE

Location:

Records:

Date -

Max. Reading -

FLOOD WATER CONTROL SYSTEM:

Warning System: NONE

Method of Controlled Releases (mechanisms):

	INLET INV. ELEV.
MAIN EMB: 2 - 24" Ø CAST IRON PIPES W/ GATE VALVES	53.8
SPILLWAY DIKE: 12" Ø CAST IRON PIPE W/ VALVE	92.0

MARTIN-DUNHAM RESV.
NY-672

DRAINAGE AREA: 11.64 SQ MI. (7452 ACRES)

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: RELATIVELY UNDEVELOPED W/ OPEN FIELDS, WOODLANDS, FORESTS

Terrain - Relief: DRAINAGEWAYS - FLAT SLOPES
ADJACENT HILLSIDES - MODERATE SLOPES HILLTOPS @ 200'-500'

Surface - Soil: GLACIAL TILL ABOVE RESV.

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

NOT KNOWN; PORTION OF WATERSHED IS CONTROLLED — NYS GRAFTON LAKES STATE PARK

Potential Sedimentation problem areas (natural or man-made; present or future)

N/A

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

NONE APPARENT

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: NONE

Elevation:

Reservoir:

Length @ Maximum Pool ± 0.7 (Miles)

Length of Shoreline (@ Spillway Crest) ± 3.4 (Miles)

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	1/		
SUBJECT		**COMPUTED BY**	**DATE**
DRAINAGE AREA		WCL	2/9/81

USGS QUAD. (7.5 MIN)	SUBBASIN 1	SUBBASIN 2	SUBBASIN 3		TOTAL	
GRAFTON	28.22	14.68	26.95			
TABORTON	5.49	—	5.82			
	33.71	14.68	32.77	→	81.16	
@ 1 SQ IN = 91.827 ACRES	3095	1348	3009		7452	ACRES
SQ MI =	4.83	2.11	4.70		11.64	SQ MI.

IMPERVIOUS AREAS: ← TOTAL BASIN % IMPERV. = 4.7%

CRANBERRY POND = 0.20 → 18.3 ACRES
WHITE LILY POND = 0.20 → 18.3 ACRES } 50.4 ACRES — #1 % IMPERVIOUS = 1.6%
LAKE ELIZABETH = 0.15 → 13.8 ACRES

SHAVER POND = 0.30 → 27.5 ACRES — #2 % IMPERVIOUS = 2.0%

MILL POND = 0.19 → 17.4
SECOND POND = 0.27 → 24.8
LONG POND = 1.17 → 107.4 } 244.2 ACRES
M-D RESV. = 1.03 → 94.6

DEPTH - CONTOUR MAPS:

M-D RESV. = 100 ACRES
LONG POND = 122 ACRES
SECOND POND = 31.4 ACRES } 271.4 ACRES — #3 % IMPERVIOUS = 9.0%
MILL POND = 18 ACRES
SHAVER POND = 44 ACRES

USE

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV.	2/		
SUBJECT: WATERSHED PARAMETERS		COMPUTED BY: WCL	DATE: 2/10/81

SNYDER UNIT HYDROGRAPH:

LAG TIME : $t_p = C_t (L \times L_{cA})^{0.3}$

	SUBBASIN 1	2	3
C_t =	2.5	2.5	2.5
(MILES) L =	3.968	3.570	4.759
L_{cA} =	1.278	1.989	1.818
(HRS) t_p =	4.07	4.50	4.78

UNIT RAINFALL DURATION :

$t_r = \frac{t_p}{5.5}$

(HRS) t_r =	0.74	0.82	0.87
ADJUSTED t_R =	1.0	1.0	1.0

ADJUSTED LAG TIME : $TP = t_p + 0.25(t_R - t_r)$

TP =	4.14	4.54	4.81

PEAKING COEFFICIENT :

640 CP = 362 ← REF: CORPS ENGINEERS LOWER HUDSON RIVER BASIN STUDY (WYNANTSKILL SUBBASIN)

CP = 0.57

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PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV.	3/		
SUBJECT		**COMPUTED BY**	**DATE**
WATERSHED PARAMETERS		WCL	2/10/81

SOIL INFILTRATION (LOSS RATES):

SOIL NAMES	SCS	
WORTH	C	
EMPEYVILLE	C	INITIAL LOSS = 1.0 INS
WESTBURY	C	CONSTANT " = 0.1 INS/HR
DANNEMORA	D	

BASE FLOW:

REF: CORPS ENGINEERS LOWER HUDSON RIVER BASIN STUDY (WYNANTSKILL SUBBASIN) } RTIOR = 3

	SUBBASIN 1	SUBBASIN 2	SUBBASIN 3	
DRAINAGE AREA (SQ MI.)	4.83	2.11	4.70	
DA ≈	5	2	5	(USE)
FROM GAGE DATA — CSM =	1	1	1	
INITIAL BASE FLOW	5	2	5	
QRCSN	15	6	15	

PMP RAINFALL — HRR #33:

200 SQ MI/24 HR INDEX RAINFALL = 19 INS. (ZONE 1)

ADJUSTMENT FOR AREA/DURATION:

(HRS) →	6	12	24	48
% OF INDEX →	109.5 (110)	121.5 (122)	130.5 (130)	140

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PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	4/		
SUBJECT		**COMPUTED BY**	**DATE**
STAGE - SURFACE AREA CALCULATION		WCL	2/17/81

PLANIMETERED AREAS @ CONTOUR ELEVATION:

SHEET NO. (GRID SQ.)	55	60	65	70	75	80	CALIBRATION FACTOR
A	—	1.25	5.83	18.08	23.57	29.53	" ← ACTUAL AREA
B	—	—	0.05	6.30	9.48	11.97	" ← ACTUAL AREA
C	—	—	—	—	—	5.40	" ← ACTUAL AREA
D	—	—	—	—	—	—	" ← ACTUAL AREA
E	—	—	—	—	—	—	" ← ACTUAL AREA
SUBTOTAL:	—	1.25	5.88	24.38	33.05	46.90	PLAN (SCALE): GRID: X

GA-17 (4/70) NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	5/		
SUBJECT		**COMPUTED BY**	**DATE**
STAGE - SURFACE AREA CALCULATION		WCL	2/17/81

PLANIMETERED AREAS @ CONTOUR ELEVATION:

SHEET NO. (GRID SQ.)	CALIBRATION FACTOR: 110	105	100	95	90	85
A	52.05 2.55	50.62 2.55	48.99 2.55	43.10 2.55	40.83	35.47
B	37.19 (− 0.45)	34.23 (− 2.19)	26.75	22.00	18.33	14.31 0.91
C	39.50	35.55	31.07	24.70	19.12	13.73
D	25.76	20.74	12.03	0.36	0.22	—
E	13.07	7.17	0.59	—	—	—
SUBTOTAL:	169.67	148.67	121.98	92.71	78.49	64.42

Column headings for each sheet: " ← ACTUAL AREA

PLAN (SCALE): GRID: ×

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

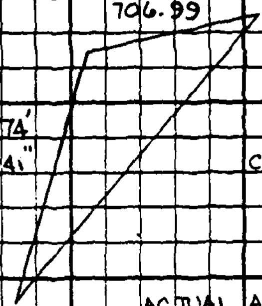
JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	6/		
SUBJECT		**COMPUTED BY**	**DATE**
		WCL	2/17/81

CALIBRATION :

PLANIMETERED AREA VS ACTUAL AREA

TRIANGULAR AREA NEAR DAM OUTLET

706.99' @ N 76°-00'-11"



1246.74'
@ N 11°-39'-41"

CALCULATED :
3RD SIDE = 1678.548'

ACTUAL AREA = 397258.17 ft²

PLANIMETERED SAME TRIANGLE
MAP SCALE: 1" = 200'

(3 RUNS) AVE = 11.2933 IN²

AREA = 451732 ft²

CALIBRATION FACTOR :

$$\frac{\text{ACTUAL}}{\text{PLANIMETERED}} = 0.8794$$

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PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	7/		
SUBJECT		COMPUTED BY	DATE
STAGE - SURFACE AREA CALCULATION		WCL	2/17/81

ACTUAL AREA @ CONTOUR ELEVATION:

SHEET NO.	55	60	65	70	75	80
PLANIMETERED (SQ IN)	—	1.25	5.88	24.38	33.05	46.90
ACTUAL	—	1.099	5.171	21.44	29.064	41.244
ACRES	—	1.009	4.748	19.688	26.689	37.873

	85	90	95	100	105	110
PLANIMETERED (SQ IN)	64.42	78.49	92.71	121.98	148.67	169.67
ACTUAL	56.651	69.024	81.529	107.269	130.74	149.208
ACRES	52.021	63.383	74.866	98.502	120.055	137.013

SUM(Σ):

CALIBRATION FACTOR = $\frac{\text{ACTUAL}}{\text{PLANIM}}$ = 0.8794

PLAN (SCALE): 1" = 200' → 1 SQ IN = 40000 FT^2

= 0.91827 ACRES

AREA:

CONTOUR

SURFACE AREA

( )

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN – DUNHAM RESV.	8/		
SUBJECT: STAGE - STORAGE DATA		COMPUTED BY: WCL	DATE: 2/17/81

REF: SHT 7/

(PLAN) ELEV.	ΔH (FT)	AREA (ACRES)	ΔVOL.	CUM. VOL. (AC-FT)	
55		0		0	
	5		2.5		
60		1.01		2.5	
	5		14.4		
65		4.75		16.9	
	5		61.1		
70		19.69		78.0	
	5		115.9		
75		26.69		193.9	
	5		161.4		
80		37.87		355.3	
	5		224.7		
85		52.02		580.0	
	5		288.5		
90		63.38		868.5	
	5		345.6		
95		74.87		1214.1	
	5		433.4		
100		98.50		1647.5	← SPILLWAY CREST
	5		546.4		
105		120.06		2193.9	
	1		128.5		
106			642.6	2322.4	← TOP DAM
	5' 4		514.1		
110		137.01		2836.5	

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

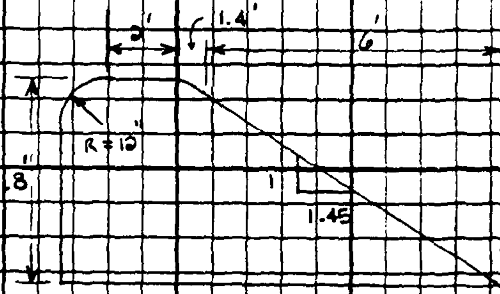
JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	9		
SUBJECT		**COMPUTED BY**	**DATE**
SPILLWAY DISCHARGES		WCL	2/17/81

WEIR FLOW : $Q = CLH^{3/2}$

$L = 100'$

$C = 3.1$

$Q = 310\,H^{3/2}$



TYPICAL SECTION
(EXTERIOR GEOMETRY)

(PLAN) ELEV.	H	(cfs) Q	
100	—	—	← DIKE CREST
101	1	310	
102	2	877	
103	3	1611	
104	4	2480	
105	5	3466	
106	6	4556	← TOP DAM

TOP OF DAM : ELEV: 106

WEIR FLOW → $Q = CLH^{3/2}$
(BROAD-CRESTED)

$C = 2.63$ $L = 1110'$

EMBANKMENT @ SPILLWAY — L = 450' MAIN EMBANKMENT — L = 660'

RT — L = 102'

LT — L = 348'

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Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	10/		
SUBJECT		COMPUTED BY	DATE
DISCHARGE CAPACITY - TWIN 24" PIPES - MAIN EMBANKMENT		WCL	2/18/81

FOR WATER SURFACE @ SPILLWAY CREST (ELEV. 100) - ALL GATES FULLY OPEN

LEFT SIDE - PIPE #2	ITEM	PIPE #1 - RT SIDE
24" Ø CAST IRON n = 0.015	BOTH	n = 0.015 24" CAST IRON
	AREA = 3.142 ft²	
53.8	INLET INVERT	53.8
EXTERNAL VERT. SLIDE GATE	CONTROLLED ENTR.	NO
± 133'	PIPE	± 130'
ONE	GATEHOUSE DOUBLE GATED VALVE w/ NON-RISING STEM (VERTICAL OPENING)	ONE
± 129'	PIPE	± 132'
ONE	VALVE WELL (VERTICAL OPNG) SLUICE GATES	ONE
± 6'	PIPE	± 6'
ONE	FLAP VALVE - EXIT	ONE
48	OUTLET INVERT	48

PIPE FLOW:

$$Z_1 + \frac{P_1}{\gamma} + \alpha\frac{V_1^2}{2g} = Z_2 + \frac{P_2}{\gamma} + \alpha\frac{V_2^2}{2g} + \Sigma h_L$$

$P_1 = 0$ $V_1 \approx 0$ $P_2 = 0$

$Z_1 = 100$ $Z_2 = 49 = (48 + 1)$

$$Z_1 - Z_2 = \alpha\frac{V_2^2}{2g} + \Sigma K\frac{V_2^2}{2g}$$

CAST IRON
FOR n = 0.015
24" Ø f = 0.034

$h_L = K\frac{V^2}{2g}$
OR
$h_f = f\frac{L}{D}\frac{V^2}{2g}$

$$(100 - 49) = \frac{V^2}{2g} + \Big[\underset{\text{ENTR.}}{2.5} + \underset{\substack{\text{PIPE}\\(0.017 \times 130)}}{2.21} + \underset{\text{GATE}}{0.19} + \underset{\substack{\text{PIPE}\\(0.017 \times 132)}}{2.24} + \underset{\text{GATE}}{0.19} + \underset{\substack{\text{PIPE}\\(0.017 \times 6)}}{0.1} + \underset{\text{EXIT}}{1.0}\Big]\frac{V^2}{2g}$$ PIPE #1

$$51 = (1 + 6.43)\frac{V^2}{2g}$$

$V = 21.02$ fps
$A = 3.142$ ft²
$Q = 66$ cfs

132 cfs ← TOTAL

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN - DUNHAM RESV. NY-672	11		
SUBJECT		**COMPUTED BY**	**DATE**
DISCHARGE CAPACITY - 12" PIPE - @ EMBANKMENT SPILLWAY		WCL	2/18/81

FOR WATER SURFACE @ SPILLWAY CREST (ELEV. 100) - ALL GATES FULLY OPEN

ITEM

12" Ø CAST IRON PIPE n = 0.015 AREA = 0.7854 ft^2

ENTRANCE SCREEN		SCREEN LOSS:
INLET INVERT	92	$K_{sc} = 1.45 - 0.45\left(\frac{a_n}{a_g}\right) - \left(\frac{a_n}{a_g}\right)^2$
PIPE	± 35'	FOR $a_n = 0.5\, a_g$
VALVE		$K_{sc} = 1.45 - 0.225 - 0.25$
PIPE	± 40'	$K_{sc} = 0.975$
VALVE		
PIPE	± 6'	
FLAP VALVE - EXIT		
OUTLET INVERT	91.5	

PIPE FLOW:

CAST IRON
FOR n = 0.015
12" Ø f = 0.0425

$$z_1 + \frac{P_1}{\gamma} + \alpha\frac{V_1^2}{2g} = z_2 + \frac{P_2}{\gamma} + \alpha\frac{V_2^2}{2g} + \Sigma h_L$$

$P_1 = 0$ $V_1 \approx 0$ $P_2 = 0$

$h_L = K\frac{V^2}{2g}$

$z_1 = 100$ $z_2 = 92 = (91.5 + 0.5)$

OR

$h_f = f\frac{L}{D}\frac{V^2}{2g}$

$$z_1 - z_2 = \alpha\frac{V_2^2}{2g} + \Sigma K\frac{V_2^2}{2g}$$

SCREEN ENTR. PIPE VALVE PIPE VALVE PIPE EXIT

$$(100 - 92) = \frac{V^2}{2g} + \left[0.975 + 0.5 + \underset{(0.0425 \times 35)}{1.49} + 0.19 + \underset{(f \times 40)}{1.70} + 0.19 + \underset{(f \times 6)}{0.26} + 1.0\right]\frac{V^2}{2g}$$

$$8 = (1 + 6.305)\frac{V^2}{2g}$$

V = 8.398 fps
A = 0.7854 ft^2

Q = 6.6 cfs ←

```
******************************                                    ********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)                                  NEW YORK STATE
DAM SAFETY VERSION      JULY 1978                                 DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79                                    FLOOD PROTECTION BUREAU
  MODIFIED FOR HONEYWELL APR 79
******************************                                    ********************************
       A    NY-672    MARTIN - DUNHAM RESERVOIR                   LOWER HUDSON RIVER BASIN
       A              DEC 2430-1430 LH -- QUACKENKILL             RENSSELAER COUNTY
       A              NYS - CAPITAL DISTRICT PARK COMM.           SNYDER UH WITH SUBBASINS
       B     100         1       0       0       0       0       0       0       0       0
       B1      5

       J       1         8       1

       J1   0.35      0.36    0.37    0.38    0.39    0.40    0.50       1

       K       0     BSN-1                                       1

       K1              INFLOW HYDROGRAPH -- SUBBASIN 1

       M       1         1    4.83            11.64                              1

       P                19     110     122     130     140

       T                                                      1.0     0.1              0.016

       W    4.14      0.57

       X       5        15       3

       K       0     BSN-2                                       1

       K1              INFLOW HYDROGRAPH -- SUBBASIN 2

       M       1         1    2.11            11.64                              1

       P                19     110     122     130     140

       T                                                      1.0     0.1               0.02

       W    4.54      0.57

       X       2         6       3

       K       0     BSN-3                                       1

       K1              INFLOW HYDROGRAPH -- SUBBASIN 3

       M       1         1    4.70            11.64                              1

       P                19     110     122     130     140

       T                                                      1.0     0.1               0.09

       W    4.81      0.57

       X       5        15       3

       K       3       DAM                                       1

       K1              COMBINED HYDROGRAPHS AT DAM  --  SUBBASINS 1-2-3

       K       1       DAM                                       1

       K1              ROUTED OUTFLOW - DAM - SPILLCREST ELEV 100-PLAN  --  1316.9-USGS
```

```
K1           ROUTED OUTFLOW - [illegible] - SPILLCREST ELEV 100-PLAN -- 1316.9-USGS
Y                                 1       1
Y1     1                                                -100      -1
Y4   100     101     102     103     104     105     106
Y5     0     310     877    1611    2480    3466    4556
$S     0   193.9   355.3     580   868.5  1214.1  1647.5  2193.9  2322.4  2836.5
$E    55      75      80      85      90      95     100     105     106     110
$$   100
SD   106    2.63     1.5    1110
K     99
A
A
A
A
A
```

```
PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS
          RUNOFF HYDROGRAPH AT          BSN-1
          RUNOFF HYDROGRAPH AT          BSN-2
          RUNOFF HYDROGRAPH AT          BSN-3
          COMBINE  3 HYDROGRAPHS AT       DAM
          ROUTE HYDROGRAPH TO             DAM
          END OF NETWORK
```

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**********************************                              **********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)                                NEW YORK STATE
DAM SAFETY VERSION       JULY 1978                              DEPT OF ENVIRONMENTAL CONSERVATION
  LAST MODIFICATION  26 FEB 79                                  FLOOD PROTECTION BUREAL
   MODIFIED FOR HONEYWELL APR 79
**********************************                              **********************************

RUN  DATE 02/20/81
                     NY-672    MARTIN - CUNHAM RESERVOIR                 LOWER HUDSON RIVER BASIN
                               DEC 243C-1430 LH -- QUACKENKILL           RENSSELAER COUNTY
                               NYS - CAPITAL DISTRICT PARK COMM.         SNYDER UH WITH SUBBASINS

                                            JOB SPECIFICATION
                 NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                100        1        0        0       0        0        0        0        0        0
                                         JOPER     NWT    LROPT    TRACE
                                             5       0        0        0

                                   MULTI-PLAN ANALYSES TO BE PERFORMED
                                     NPLAN= 1 NRTIO= 9 LRTIO= 1
                     RTIOS=   0.35    0.36    0.37    0.38    0.39    0.40    0.50    1.00

            **********          **********          **********          **********          **********

                                       SUB-AREA RUNOFF COMPUTATION

                              INFLOW HYDROGRAPH -- SUBBASIN 1
                                ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                                BSN-1        0        0        0        0        0        1        0        0

                                              HYDROGRAPH DATA
                IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
                    1        1     4.83       0.    11.64       0.       0.        0        1        0

                                               PRECIP DATA
                              SPFE      PMS       R6      R12      R24      R48      R72      R96
                                0.    19.00   110.00   122.00   130.00   140.00       0.       0.
TRSPC COMPUTED BY THE PROGRAM IS 0.805

                                                LOSS DATA
            LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
                0       0.       0.     1.00       0.       0.     1.00     1.00     0.10       0.     0.02

                                          UNIT HYDROGRAPH DATA
                                     TP=  4.14     CP=0.57     NTA=  0

                                              RECESSION DATA
                               STRTQ=     5.00     QRCSN=   15.00     RTIOR= 3.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 4.81 AND R= 4.45 INTERVALS

                UNIT HYDROGRAPH 27 END-OF-PERIOD ORDINATES, LAG=   4.15 HOURS, CP= 0.57  VOL= 1.00
            42.       153.       292.       398.       420.       366.       292.       233.       186.       148.
           118.        94.        75.        60.        48.        38.        31.        24.        19.        15.
            12.        10.         8.         6.         5.         4.         3.

      0                                            END-OF-PERIOD FLOW
     MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q        MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
      1.01   1.00       1   0.01   0.00   0.01        4.         1.03   3.00      51     0.     0.     0.     1570.
      1.01   2.00       2   0.01   0.00   0.01        4.         1.03   4.00      52     0.     0.     0.     1256.
      1.01   3.00       3   0.01   0.00   0.01        4.         1.03   5.00      53     0.     0.     0.     1003.
      1.01   4.00       4   0.01   0.00   0.01        3.         1.03   6.00      54     0.     0.     0.      800.
```

1.01	3.00	3	0.01	0.00	0.01	4.	1.03	5.00	53	0.	0.	0.	1003.
1.01	4.00	4	0.01	0.00	0.01	3.	1.03	6.00	54	0.	0.	0.	800.
1.01	5.00	5	0.01	0.00	0.01	3.	1.03	7.00	55	0.	0.	0.	638.
1.01	6.00	6	0.01	0.00	0.01	3.	1.03	8.00	56	0.	0.	0.	509.
1.01	7.00	7	0.02	0.00	0.02	3.	1.03	9.00	57	0.	0.	0.	406.
1.01	8.00	8	0.02	0.00	0.02	2.	1.03	10.00	58	0.	0.	0.	324.
1.01	9.00	9	0.02	0.00	0.02	2.	1.03	11.00	59	0.	0.	0.	258.
1.01	10.00	10	0.02	0.00	0.02	2.	1.03	12.00	60	0.	0.	0.	205.
1.01	11.00	11	0.02	0.00	0.02	2.	1.03	13.00	61	0.	0.	0.	163.
1.01	12.00	12	0.02	0.00	0.02	2.	1.03	14.00	62	0.	0.	0.	130.
1.01	13.00	13	0.13	0.00	0.13	2.	1.03	15.00	63	0.	0.	0.	103.
1.01	14.00	14	0.16	0.00	0.15	2.	1.03	16.00	64	0.	0.	0.	78.
1.01	15.00	15	0.19	0.00	0.19	3.	1.03	17.00	65	0.	0.	0.	57.
1.01	16.00	16	0.49	0.13	0.37	9.	1.03	18.00	66	0.	0.	0.	40.
1.01	17.00	17	0.18	0.08	0.10	27.	1.03	19.00	67	0.	0.	0.	16.
1.01	18.00	18	0.14	0.04	0.10	55.	1.03	20.00	68	0.	0.	0.	14.
1.01	19.00	19	0.01	0.00	0.01	85.	1.03	21.00	69	0.	0.	0.	12.
1.01	20.00	20	0.01	0.00	0.01	102.	1.03	22.00	70	0.	0.	0.	11.
1.01	21.00	21	0.01	0.00	0.01	101.	1.03	23.00	71	0.	0.	0.	10.
1.01	22.00	22	0.01	0.00	0.01	88.	1.04	0.	72	0.	0.	0.	9.
1.01	23.00	23	0.01	0.00	0.01	71.	1.04	1.00	73	0.	0.	0.	8.
1.02	0.	24	0.01	0.00	0.01	57.	1.04	2.00	74	0.	0.	0.	7.
1.02	1.00	25	0.08	0.00	0.08	46.	1.04	3.00	75	0.	0.	0.	6.
1.02	2.00	26	0.08	0.00	0.08	37.	1.04	4.00	76	0.	0.	0.	6.
1.02	3.00	27	0.08	0.00	0.08	30.	1.04	5.00	77	0.	0.	0.	5.
1.02	4.00	28	0.08	0.00	0.08	25.	1.04	6.00	78	0.	0.	0.	5.
1.02	5.00	29	0.08	0.00	0.08	20.	1.04	7.00	79	0.	0.	0.	4.
1.02	6.00	30	0.08	0.00	0.08	17.	1.04	8.00	80	0.	0.	0.	4.
1.02	7.00	31	0.31	0.21	0.10	23.	1.04	9.00	81	0.	0.	0.	3.
1.02	8.00	32	0.31	0.21	0.10	53.	1.04	10.00	82	0.	0.	0.	3.
1.02	9.00	33	0.31	0.21	0.10	111.	1.04	11.00	83	0.	0.	0.	3.
1.02	10.00	34	0.31	0.21	0.10	192.	1.04	12.00	84	0.	0.	0.	2.
1.02	11.00	35	0.31	0.21	0.10	278.	1.04	13.00	85	0.	0.	0.	2.
1.02	12.00	36	0.31	0.21	0.10	352.	1.04	14.00	86	0.	0.	0.	2.
1.02	13.00	37	1.68	1.58	0.10	470.	1.04	15.00	87	0.	0.	0.	2.
1.02	14.00	38	2.04	1.92	0.10	742.	1.04	16.00	88	0.	0.	0.	2.
1.02	15.00	39	2.52	2.43	0.10	1255.	1.04	17.00	89	0.	0.	0.	1.
1.02	16.00	40	6.40	6.30	0.10	2172.	1.04	18.00	90	0.	0.	0.	1.
1.02	17.00	41	2.36	2.26	0.10	3479.	1.04	19.00	91	0.	0.	0.	1.
1.02	18.00	42	1.85	1.75	0.10	4835.	1.04	20.00	92	0.	0.	0.	1.
1.02	19.00	43	0.12	0.02	0.10	5797.	1.04	21.00	93	0.	0.	0.	1.
1.02	20.00	44	0.12	0.02	0.10	6021.	1.04	22.00	94	0.	0.	0.	1.
1.02	21.00	45	0.12	0.02	0.10	5526.	1.04	23.00	95	0.	0.	0.	1.
1.02	22.00	46	0.12	0.02	0.10	4670.	1.05	0.	96	0.	0.	0.	1.
1.02	23.00	47	0.12	0.02	0.10	3794.	1.05	1.00	97	0.	0.	0.	1.
1.03	0.	48	0.12	0.02	0.10	3042.	1.05	2.00	98	0.	0.	0.	1.
1.03	1.00	49	0.	0.	0.	2441.	1.05	3.00	99	0.	0.	0.	0.
1.03	2.00	50	0.	0.	0.	1959.	1.05	4.00	100	0.	0.	0.	0.

SUM 21.42 17.90 3.52 55709.
(544.)(455.)(89.)(1577.50)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6021.	5081.	2222.	773.	55701.
CMS	170.	144.	63.	22.	1577.
INCHES		9.79	17.12	17.86	17.88
MM		248.55	434.80	453.74	454.14
AC-FT		2519.	4407.	4599.	4603.
THOUS CU M		3108.	5436.	5673.	5678.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 1

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	3.	9.	19.	30.	36.
35.	31.	25.	20.	16.	13.	10.	9.	7.	6.

57.	[illegible]	38.	27.	20.	14.	9.	9.	4.	4.
3.	3.	3.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2167.	1778.	778.	271.	19495.
CMS	60.	50.	22.	8.	552.
INCHES		3.42	5.99	6.25	6.26
MM		86.99	152.18	158.81	158.95
AC-FT		882.	1543.	1610.	1611.
THOUS CU M		1088.	1903.	1986.	1987.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 2

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	3.	10.	20.	30.	37.
36.	32.	26.	21.	16.	13.	11.	9.	7.	6.
8.	15.	40.	69.	100.	127.	169.	267.	452.	782.
1252.	1741.	2087.	2167.	1989.	1681.	1366.	1095.	879.	705.
565.	452.	361.	288.	230.	183.	146.	116.	93.	74.
59.	47.	37.	28.	21.	14.	6.	5.	4.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2167.	1829.	800.	278.	20052.
CMS	61.	52.	23.	8.	568.
INCHES		3.52	6.16	6.43	6.44
MM		89.46	156.53	163.35	163.49
AC-FT		907.	1587.	1656.	1657.
THOUS CU M		1119.	1957.	2042.	2044.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 3

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	3.	10.	20.	31.	38.
37.	32.	26.	21.	17.	14.	11.	9.	8.	6.
9.	19.	41.	71.	103.	130.	174.	275.	465.	804.
1287.	1789.	2145.	2228.	2045.	1728.	1404.	1126.	903.	725.
581.	465.	371.	296.	236.	188.	150.	120.	95.	76.
60.	48.	38.	29.	21.	15.	6.	5.	4.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2228.	1880.	822.	286.	20609.
CMS	63.	53.	23.	8.	584.
INCHES		3.62	6.33	6.61	6.62
MM		91.96	160.88	167.86	168.03
AC-FT		932.	1631.	1702.	1703.
THOUS CU M		1150.	2011.	2099.	2101.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 4

2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	3.	10.	21.	32.	39.
38.	33.	27.	22.	17.	14.	11.	9.	8.	6.
9.	20.	42.	73.	105.	134.	179.	282.	477.	826.
1322.	1837.	2203.	2288.	2100.	1775.	1442.	1156.	928.	744.
597.	477.	381.	304.	242.	193.	154.	123.	98.	78.
62.	49.	39.	30.	22.	15.	6.	5.	5.	4.
4.	3.	3.	3.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.

1.	1.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2406.	2032.	869.	309.	22260.
CMS	68.	58.	25.	9.	631.
INCHES		3.91	6.85	7.15	7.15
MM		99.42	173.92	181.50	181.66
AC-FT		1008.	1763.	1840.	1841.
THOUS CU M		1243.	2175.	2269.	2271.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 7

2.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	4.	13.	28.	42.	51.
50.	44.	36.	29.	23.	18.	15.	12.	10.	9.
12.	26.	56.	96.	139.	176.	235.	371.	628.	1086.
1739.	2417.	2898.	3010.	2763.	2335.	1897.	1521.	1221.	979.
785.	626.	501.	400.	319.	255.	203.	162.	129.	102.
81.	65.	51.	39.	29.	20.	8.	7.	6.	5.
5.	4.	4.	4.	3.	3.	3.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3010.	2540.	1111.	386.	27851.
CMS	85.	72.	31.	11.	789.
INCHES		4.89	8.56	8.93	8.94
MM		124.27	217.40	226.87	227.07
AC-FT		1260.	2204.	2300.	2302.
THOUS CU M		1554.	2718.	2837.	2839.

HYDROGRAPH AT STA BSN-1 FOR PLAN 1, RTIO 8

4.	4.	4.	3.	3.	3.	3.	2.	2.	2.
2.	2.	2.	2.	3.	9.	27.	55.	85.	102.
101.	88.	71.	57.	46.	37.	30.	25.	20.	17.
23.	53.	111.	192.	278.	352.	470.	742.	1255.	2172.
3479.	4835.	5797.	6021.	5526.	4670.	3794.	3042.	2441.	1959.
1570.	1256.	1003.	800.	638.	509.	406.	324.	258.	205.
163.	130.	103.	78.	57.	40.	16.	14.	12.	11.
10.	9.	8.	7.	6.	6.	5.	5.	4.	4.
3.	3.	3.	2.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6021.	5081.	2222.	773.	55701.
CMS	170.	144.	63.	22.	1577.
INCHES		9.79	17.12	17.86	17.88
MM		248.55	434.80	453.74	454.14
AC-FT		2519.	4407.	4599.	4603.
THOUS CU M		3108.	5436.	5673.	5678.

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH -- SUBBASIN 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BSN-2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG IUHG TAREA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL

CFS	6021.	5081.	2222.	773.	55701.
CMS	170.	144.	63.	22.	1577.
INCHES		9.79	17.12	17.86	17.86
MM		248.55	434.80	453.74	454.14
AC-FT		2519.	4407.	4599.	4603.
THOLS CU M		3108.	5436.	5673.	5678.

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH -- SUBBASIN 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BSN-2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.11	0.	11.64	0.	0.	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	19.00	110.00	122.00	130.00	140.00	0.	0.

TRSPC COMPUTED BY THE PROGRAM IS 0.605

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.	0.	1.00	0.	0.	1.00	1.00	0.10	0.	0.02

UNIT HYDROGRAPH DATA

TP= 4.54 CP=0.57 NTA= 0

RECESSION DATA

STRTQ= 2.00 QRCSN= 6.00 RTIOR= 3.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.05 AND R= 5.03 INTERVALS

UNIT HYDROGRAPH 30 END-OF-PERIOD ORDINATES, LAG= 4.55 HOURS, CP= 0.57 VOL= 1.00

15.	56.	109.	152.	169.	155.	127.	104.	85.	70.
57.	47.	38.	32.	26.	21.	17.	14.	12.	10.
8.	6.	5.	4.	4.	3.	2.	2.	2.	1.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	1.00	1	0.01	0.00	0.01	2.	1.03	3.00	51	0.	0.	0.	779.
1.01	2.00	2	0.01	0.00	0.01	2.	1.03	4.00	52	0.	0.	0.	640.
1.01	3.00	3	0.01	0.00	0.01	1.	1.03	5.00	53	0.	0.	0.	524.
1.01	4.00	4	0.01	0.00	0.01	1.	1.03	6.00	54	0.	0.	0.	429.
1.01	5.00	5	0.01	0.00	0.01	1.	1.03	7.00	55	0.	0.	0.	352.
1.01	6.00	6	0.01	0.00	0.01	1.	1.03	8.00	56	0.	0.	0.	288.
1.01	7.00	7	0.02	0.00	0.02	1.	1.03	9.00	57	0.	0.	0.	236.
1.01	8.00	8	0.02	0.00	0.02	1.	1.03	10.00	58	0.	0.	0.	193.
1.01	9.00	9	0.02	0.00	0.02	1.	1.03	11.00	59	0.	0.	0.	158.
1.01	10.00	10	0.02	0.00	0.02	1.	1.03	12.00	60	0.	0.	0.	130.
1.01	11.00	11	0.02	0.00	0.02	1.	1.03	13.00	61	0.	0.	0.	106.
1.01	12.00	12	0.02	0.00	0.02	1.	1.03	14.00	62	0.	0.	0.	87.
1.01	13.00	13	0.13	0.00	0.13	1.	1.03	15.00	63	0.	0.	0.	71.
1.01	14.00	14	0.16	0.00	0.15	1.	1.03	16.00	64	0.	0.	0.	58.
1.01	15.00	15	0.19	0.00	0.19	1.	1.03	17.00	65	0.	0.	0.	47.
1.01	16.00	16	0.49	0.13	0.37	4.	1.03	18.00	66	0.	0.	0.	38.
1.01	17.00	17	0.18	0.08	0.10	10.	1.03	19.00	67	0.	0.	0.	30.
1.01	18.00	18	0.14	0.04	0.10	21.	1.03	20.00	68	0.	0.	0.	22.
1.01	19.00	19	0.01	0.00	0.01	33.	1.03	21.00	69	0.	0.	0.	16.
1.01	20.00	20	0.01	0.00	0.01	41.	1.03	22.00	70	0.	0.	0.	6.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.01	10.00	10	0.02	0.00	0.02	1.	1.03	12.00	60	0.	0.	0.	130.
1.01	11.00	11	0.02	0.00	0.02	1.	1.03	13.00	61	0.	0.	0.	106.
1.01	12.00	12	0.02	0.00	0.02	1.	1.03	14.00	62	0.	0.	0.	87.
1.01	13.00	13	0.13	0.00	0.13	1.	1.03	15.00	63	0.	0.	0.	71.
1.01	14.00	14	0.16	0.00	0.15	1.	1.03	16.00	64	0.	0.	0.	58.
1.01	15.00	15	0.19	0.00	0.19	1.	1.03	17.00	65	0.	0.	0.	47.
1.01	16.00	16	0.49	0.13	0.37	4.	1.03	18.00	66	0.	0.	0.	38.
1.01	17.00	17	0.18	0.08	0.10	10.	1.03	19.00	67	0.	0.	0.	30.
1.01	18.00	18	0.14	0.04	0.10	21.	1.03	20.00	68	0.	0.	0.	22.
1.01	19.00	19	0.01	0.00	0.01	33.	1.03	21.00	69	0.	0.	0.	16.
1.01	20.00	20	0.01	0.00	0.01	41.	1.03	22.00	70	0.	0.	0.	6.
1.01	21.00	21	0.01	0.00	0.01	42.	1.03	23.00	71	0.	0.	0.	5.
1.01	22.00	22	0.01	0.00	0.01	38.	1.04	0.	72	0.	0.	0.	5.
1.01	23.00	23	0.01	0.00	0.01	32.	1.04	1.00	73	0.	0.	0.	4.
1.02	0.	24	0.01	0.00	0.01	26.	1.04	2.00	74	0.	0.	0.	4.
1.02	1.00	25	0.08	0.00	0.08	21.	1.04	3.00	75	0.	0.	0.	3.
1.02	2.00	26	0.08	0.00	0.08	18.	1.04	4.00	76	0.	0.	0.	3.
1.02	3.00	27	0.08	0.00	0.08	15.	1.04	5.00	77	0.	0.	0.	3.
1.02	4.00	28	0.08	0.00	0.08	12.	1.04	6.00	78	0.	0.	0.	3.
1.02	5.00	29	0.08	0.00	0.08	11.	1.04	7.00	79	0.	0.	0.	2.
1.02	6.00	30	0.08	0.00	0.08	9.	1.04	8.00	80	0.	0.	0.	2.
1.02	7.00	31	0.31	0.21	0.10	11.	1.04	9.00	81	0.	0.	0.	2.
1.02	8.00	32	0.31	0.21	0.10	22.	1.04	10.00	82	0.	0.	0.	2.
1.02	9.00	33	0.31	0.21	0.10	43.	1.04	11.00	83	0.	0.	0.	1.
1.02	10.00	34	0.31	0.21	0.10	74.	1.04	12.00	84	0.	0.	0.	1.
1.02	11.00	35	0.31	0.21	0.10	108.	1.04	13.00	85	0.	0.	0.	1.
1.02	12.00	36	0.31	0.21	0.10	140.	1.04	14.00	86	0.	0.	0.	1.
1.02	13.00	37	1.68	1.59	0.10	187.	1.04	15.00	87	0.	0.	0.	1.
1.02	14.00	38	2.02	1.92	0.10	290.	1.04	16.00	88	0.	0.	0.	1.
1.02	15.00	39	2.52	2.43	0.10	484.	1.04	17.00	89	0.	0.	0.	1.
1.02	16.00	40	6.40	6.30	0.10	831.	1.04	18.00	90	0.	0.	0.	1.
1.02	17.00	41	2.36	2.26	0.10	1337.	1.04	19.00	91	0.	0.	0.	1.
1.02	18.00	42	1.85	1.75	0.10	1881.	1.04	20.00	92	0.	0.	0.	1.
1.02	19.00	43	0.12	0.02	0.10	2298.	1.04	21.00	93	0.	0.	0.	0.
1.02	20.00	44	0.12	0.02	0.10	2459.	1.04	22.00	94	0.	0.	0.	0.
1.02	21.00	45	0.12	0.02	0.10	2335.	1.04	23.00	95	0.	0.	0.	0.
1.02	22.00	46	0.12	0.02	0.10	2034.	1.05	0.	96	0.	0.	0.	0.
1.02	23.00	47	0.12	0.02	0.10	1701.	1.05	1.00	97	0.	0.	0.	0.
1.03	0.	48	0.12	0.02	0.10	1399.	1.05	2.00	98	0.	0.	0.	0.
1.03	1.00	49	0.	0.	0.	1152.	1.05	3.00	99	0.	0.	0.	0.
1.03	2.00	50	0.	0.	0.	948.	1.05	4.00	100	0.	0.	0.	0.

SUM 21.42 17.92 3.51 24342.
(544.)(455.)(89.)(689.29)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2459.	2088.	961.	338.	24340.
CMS	70.	59.	27.	10.	689.
INCHES		9.20	16.95	17.87	17.88
MM		233.76	430.55	453.85	454.27
AC-FT		1035.	1907.	2010.	2012.
THOUS CU M		1277.	2352.	2479.	2481.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 1

1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	4.	7.	11.	14.
15.	13.	11.	9.	8.	6.	5.	4.	4.	3.
4.	8.	15.	26.	38.	49.	65.	102.	169.	251.
468.	658.	804.	861.	817.	712.	595.	450.	403.	332.
273.	224.	184.	150.	123.	101.	83.	68.	55.	45.
37.	30.	25.	20.	15.	13.	10.	8.	5.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 2

1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	4.	8.	12.	15.
15.	14.	11.	9.	8.	6.	5.	4.	4.	3.
4.	6.	16.	27.	39.	50.	67.	104.	174.	259.
481.	677.	827.	885.	840.	732.	612.	504.	415.	341.
281.	230.	169.	155.	127.	104.	85.	70.	57.	47.
38.	31.	25.	21.	17.	14.	11.	8.	6.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	885.	752.	346.	122.	8762.
CMS	25.	21.	10.	3.	248.
INCHES		3.31	6.10	6.43	6.44
MM		84.15	155.00	163.39	163.54
AC-FT		373.	686.	724.	724.
THOUS CU M		460.	847.	892.	893.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 3

1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	4.	8.	12.	15.
16.	14.	12.	10.	8.	7.	5.	5.	4.	3.
4.	8.	16.	27.	40.	52.	69.	107.	179.	308.
495.	696.	850.	910.	864.	753.	629.	518.	426.	351.
288.	237.	194.	159.	130.	107.	87.	71.	59.	48.
39.	32.	26.	21.	17.	14.	11.	8.	6.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	910.	772.	356.	125.	9006.
CMS	26.	22.	10.	4.	255.
INCHES		3.41	6.27	6.61	6.62
MM		86.49	159.30	167.93	168.08
AC-FT		383.	705.	744.	744.
THOUS CU M		472.	870.	917.	918.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 4

1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	1.	4.	8.	12.	15.
16.	14.	12.	10.	8.	7.	6.	5.	4.	3.
4.	8.	16.	28.	41.	53.	71.	110.	184.	316.
508.	715.	873.	935.	887.	773.	646.	532.	438.	360.
296.	243.	199.	163.	134.	109.	90.	73.	60.	49.
40.	33.	27.	22.	14.	15.	11.	8.	6.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	935.	793.	365.	128.	9249.
CMS	26.	22.	10.	4.	262.
INCHES		3.50	6.44	6.79	6.80
MM		88.63	163.61	172.46	172.62
AC-FT		393.	724.	764.	764.
THOUS CU M		485.	894.	942.	943.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 5

1.	1.	1.	1.	0.	0.	0.	0.	0.	0.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	75.	110.	193.	[illegible]
535.	757.	913.	984.	934.	814.	680.	560.	461.	379.
312.	256.	210.	172.	141.	115.	94.	77.	63.	52.
42.	35.	28.	23.	19.	15.	12.	9.	6.	2.
2.	2.	2.	2.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	984.	635.	334.	135.	9736.
CMS	28.	24.	11.	4.	276.
INCHES		3.68	6.78	7.15	7.15
MM		93.50	172.22	181.54	181.71
AC-FT		414.	763.	804.	805.
THOUS CU M		511.	941.	992.	992.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 7

1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	1.	1.	2.	5.	11.	16.	20.
21.	19.	16.	13.	11.	9.	7.	6.	5.	5.
5.	11.	22.	37.	54.	70.	93.	145.	242.	416.
668.	940.	1149.	1230.	1167.	1017.	850.	700.	576.	474.
390.	320.	262.	215.	176.	144.	118.	97.	79.	65.
53.	43.	35.	29.	23.	19.	15.	11.	8.	3.
3.	2.	2.	2.	2.	2.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1230.	1044.	491.	169.	12170.
CMS	35.	30.	14.	5.	345.
INCHES		4.60	8.48	8.93	8.94
MM		116.88	215.28	226.93	227.13
AC-FT		518.	953.	1005.	1006.
THOUS CU M		638.	1176.	1239.	1241.

HYDROGRAPH AT STA BSN-2 FOR PLAN 1, RTIO 8

2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	4.	10.	21.	33.	41.
42.	38.	32.	26.	21.	18.	15.	12.	11.	9.
11.	22.	43.	74.	108.	140.	187.	290.	484.	831.
1337.	1881.	2298.	2459.	2335.	2034.	1701.	1399.	1152.	948.
779.	640.	524.	429.	352.	288.	236.	193.	158.	130.
106.	87.	71.	58.	47.	38.	30.	22.	16.	6.
5.	5.	4.	4.	3.	3.	3.	3.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2459.	2088.	961.	338.	24340.
CMS	70.	59.	27.	10.	689.
INCHES		9.20	16.95	17.87	17.88
MM		233.76	430.55	453.85	454.27
AC-FT		1035.	1907.	2010.	2012.
THOUS CU M		1277.	2352.	2479.	2481.

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH -- SUBBASIN 3

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                              SUB-AREA RUNOFF COMPUTATION

                       INFLOW HYDROGRAPH -- SUBBASIN 3
                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                         BSN-3       0       0       0       0       0       1       0       0

                                          HYDROGRAPH DATA
                 IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                     1       1    4.70      0.   11.64      0.      0.       0       1       0

                                            PRECIP DATA
                      SPFE     PMS      R6     R12     R24     R48     R72     R96
                        0.   19.00  110.00  122.00  130.00  140.00      0.      0.
TRSPC COMPUTED BY THE PROGRAM IS 0.305

                                            LOSS DATA
             LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
                 0      0.      0.    1.00      0.      0.    1.00    1.00    0.10      0.    0.09

                                       UNIT HYDROGRAPH DATA
                                    TP=  4.81    CP=0.57    NTA=  0

                                          RECESSION DATA
                                 STRTQ=    5.00    QRCSN=   15.00    RTIOR= 3.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 5.43 AND R= 5.22 INTERVALS

                 UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG=   4.86 HOURS, CP= 0.57  VOL= 1.00
                30.     108.     212.     306.     356.     345.     293.     242.     199.     165.
               136.     112.      92.      76.      63.      52.      43.      35.      29.      24.
                20.      16.      14.      11.       9.       8.       6.       5.       4.       4.
                 3.

           0                                   END-OF-PERIOD FLOW
       MO.DA   HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q      MO.DA   HR.MN  PERIOD   RAIN   EXCS   LOSS    COMP Q
        1.01    1.00       1   0.01   0.00   0.01        4.       1.03    3.00      51     0.     0.     0.     1875.
        1.01    2.00       2   0.01   0.00   0.01        4.       1.03    4.00      52     0.     0.     0.     1552.
        1.01    3.00       3   0.01   0.00   0.01        4.       1.03    5.00      53     0.     0.     0.     1283.
        1.01    4.00       4   0.01   0.00   0.01        4.       1.03    6.00      54     0.     0.     0.     1059.
        1.01    5.00       5   0.01   0.00   0.01        3.       1.03    7.00      55     0.     0.     0.      874.
        1.01    6.00       6   0.01   0.00   0.01        3.       1.03    8.00      56     0.     0.     0.      721.
        1.01    7.00       7   0.02   0.00   0.02        3.       1.03    9.00      57     0.     0.     0.      595.
        1.01    8.00       8   0.02   0.00   0.02        3.       1.03   10.00      58     0.     0.     0.      491.
        1.01    9.00       9   0.02   0.00   0.02        4.       1.03   11.00      59     0.     0.     0.      405.
        1.01   10.00      10   0.02   0.00   0.02        4.       1.03   12.00      60     0.     0.     0.      334.
        1.01   11.00      11   0.02   0.00   0.02        4.       1.03   13.00      61     0.     0.     0.      276.
        1.01   12.00      12   0.02   0.00   0.02        5.       1.03   14.00      62     0.     0.     0.      227.
        1.01   13.00      13   0.13   0.01   0.12        6.       1.03   15.00      63     0.     0.     0.      187.
        1.01   14.00      14   0.16   0.01   0.14        7.       1.03   16.00      64     0.     0.     0.      154.
        1.01   15.00      15   0.19   0.02   0.18       10.       1.03   17.00      65     0.     0.     0.      126.
        1.01   16.00      16   0.49   0.15   0.34       17.       1.03   18.00      66     0.     0.     0.      104.
        1.01   17.00      17   0.18   0.09   0.09       35.       1.03   19.00      67     0.     0.     0.       85.
        1.01   18.00      18   0.14   0.05   0.09       61.       1.03   20.00      68     0.     0.     0.       66.
        1.01   19.00      19   0.01   0.00   0.01       89.       1.03   21.00      69     0.     0.     0.       50.
        1.01   20.00      20   0.01   0.00   0.01      108.       1.03   22.00      70     0.     0.     0.       36.
        1.01   21.00      21   0.01   0.00   0.01      114.       1.03   23.00      71     0.     0.     0.       15.
        1.01   22.00      22   0.01   0.00   0.01      105.       1.04    0.        72     0.     0.     0.       13.
        1.01   23.00      23   0.01   0.00   0.01       91.       1.04    1.00      73     0.     0.     0.       12.
        1.02    0.        24   0.01   0.00   0.01       76.       1.04    2.00      74     0.     0.     0.       11.
        1.02    1.00      25   0.08   0.01   0.07       63.       1.04    3.00      75     0.     0.     0.       10.
        1.02    2.00      26   0.08   0.01   0.07       53.       1.04    4.00      76     0.     0.     0.        9.
```

[illegible]	1.00	25	[illegible]	[illegible]	[illegible]	63.	1.04	3.00	75	0.	0.	0.	10.
1.02	2.00	26	0.03	0.01	0.07	53.	1.04	4.00	76	0.	0.	0.	9.
1.02	3.00	27	0.08	0.01	0.07	40.	1.04	5.00	77	0.	0.	0.	8.
1.02	4.00	28	0.08	0.01	0.07	41.	1.04	6.00	78	0.	0.	0.	7.
1.02	5.00	29	0.08	0.01	0.07	37.	1.04	7.00	79	0.	0.	0.	6.
1.02	6.00	30	0.08	0.01	0.07	35.	1.04	8.00	80	0.	0.	0.	6.
1.02	7.00	31	0.31	0.22	0.09	39.	1.04	9.00	81	0.	0.	0.	5.
1.02	8.00	32	0.31	0.22	0.09	59.	1.04	10.00	82	0.	0.	0.	4.
1.02	9.00	33	0.31	0.22	0.09	102.	1.04	11.00	83	0.	0.	0.	4.
1.02	10.00	34	0.31	0.22	0.09	164.	1.04	12.00	84	0.	0.	0.	4.
1.02	11.00	35	0.31	0.22	0.09	237.	1.04	13.00	85	0.	0.	0.	3.
1.02	12.00	36	0.31	0.22	0.09	308.	1.04	14.00	86	0.	0.	0.	3.
1.02	13.00	37	1.68	1.59	0.09	409.	1.04	15.00	87	0.	0.	0.	3.
1.02	14.00	38	2.02	1.93	0.09	617.	1.04	16.00	88	0.	0.	0.	2.
1.02	15.00	39	2.52	2.43	0.09	1002.	1.04	17.00	89	0.	0.	0.	2.
1.02	16.00	40	6.40	6.30	0.09	1697.	1.04	18.00	90	0.	0.	0.	2.
1.02	17.00	41	2.36	2.27	0.09	2725.	1.04	19.00	91	0.	0.	0.	2.
1.02	18.00	42	1.85	1.76	0.09	3867.	1.04	20.00	92	0.	0.	0.	1.
1.02	19.00	43	0.12	0.03	0.09	4605.	1.04	21.00	93	0.	0.	0.	1.
1.02	20.00	44	0.12	0.03	0.09	5275.	1.04	22.00	94	0.	0.	0.	1.
1.02	21.00	45	0.12	0.03	0.09	5166.	1.04	23.00	95	0.	0.	0.	1.
1.02	22.00	46	0.12	0.03	0.09	4625.	1.05	0.	96	0.	0.	0.	1.
1.02	23.00	47	0.12	0.03	0.09	3940.	1.05	1.00	97	0.	0.	0.	1.
1.03	0.	48	0.12	0.03	0.09	3282.	1.05	2.00	98	0.	0.	0.	1.
1.03	1.00	49	0.	0.	0.	2724.	1.05	3.00	99	0.	0.	0.	1.
1.03	2.00	50	0.	0.	0.	2261.	1.05	4.00	100	0.	0.	0.	1.
									SUM	21.42	18.17	3.25	54983.
										(544.)	(461.)	(83.)	(1556.95)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5275.	4564.	2149.	763.	54976.
CMS	149.	129.	61.	22.	1557.
INCHES		9.03	17.01	18.11	18.13
MM		229.45	432.07	460.06	460.62
AC-FT		2263.	4262.	4538.	4543.
THOUS CU M		2792.	5257.	5597.	5604.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 1

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	3.	6.	12.	21.	31.	38.
40.	37.	32.	27.	22.	19.	16.	14.	13.	12.
14.	21.	36.	57.	83.	108.	143.	216.	351.	594.
954.	1353.	1682.	1846.	1808.	1619.	1379.	1149.	953.	791.
656.	543.	449.	371.	305.	252.	208.	172.	142.	117.
97.	79.	65.	54.	44.	36.	30.	23.	18.	12.
5.	5.	4.	4.	3.	3.	3.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1846.	1597.	752.	267.	19241.
CMS	52.	45.	21.	8.	545.
INCHES		3.16	5.95	6.34	6.35
MM		80.31	151.22	161.02	161.22
AC-FT		792.	1492.	1538.	1590.
THOUS CU M		977.	1840.	1959.	1961.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 2

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	3.	6.	13.	22.	32.	39.
41.	39.	33.	27.	23.	19.	17.	15.	13.	12.
14.	21.	37.	57.	85.	111.	147.	222.	361.	611.
981.	1392.	1730.	1879.	1860.	1665.	1418.	1181.	981.	814.

1.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1846.	1597.	752.	267.	19241.
CMS	52.	45.	21.	8.	545.
INCHES		3.16	5.95	6.34	6.35
MM		80.31	151.22	161.02	161.22
AC-FT		792.	1492.	1588.	1590.
THOUS CU M		977.	1840.	1959.	1961.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 2

2.	1.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	2.	3.	6.	13.	22.	32.	39.
41.	38.	33.	27.	23.	19.	17.	15.	13.	12.
14.	21.	37.	59.	85.	111.	147.	222.	361.	611.
981.	1392.	1730.	1899.	1860.	1665.	1418.	1161.	981.	814.
675.	559.	462.	381.	314.	260.	214.	177.	146.	120.
99.	82.	67.	55.	45.	37.	31.	24.	18.	13.
5.	5.	4.	4.	3.	3.	3.	2.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1899.	1643.	774.	275.	19791.
CMS	54.	47.	22.	8.	560.
INCHES		3.25	6.12	6.52	6.53
MM		82.60	155.54	165.62	165.82
AC-FT		815.	1534.	1634.	1636.
THOUS CU M		1005.	1892.	2015.	2018.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 3

2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
2.	2.	2.	3.	4.	6.	13.	23.	33.	40.
42.	39.	34.	28.	23.	20.	17.	15.	14.	13.
14.	22.	38.	61.	88.	114.	151.	228.	371.	628.
1009.	1431.	1778.	1952.	1911.	1711.	1458.	1214.	1008.	836.
694.	574.	475.	392.	323.	267.	220.	182.	150.	124.
102.	84.	69.	57.	47.	38.	31.	25.	19.	13.
6.	5.	4.	4.	4.	3.	3.	3.	2.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1952.	1689.	795.	282.	20341.
CMS	55.	48.	23.	8.	576.
INCHES		3.34	6.29	6.70	6.71
MM		84.90	159.86	170.22	170.43
AC-FT		837.	1577.	1679.	1681.
THOUS CU M		1033.	1945.	2071.	2074.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 4

2.	2.	1.	1.	1.	1.	1.	1.	1.	2.
2.	2.	2.	3.	4.	7.	13.	23.	34.	41.
43.	40.	34.	29.	24.	20.	17.	15.	14.	13.
15.	23.	39.	62.	90.	117.	155.	235.	381.	645.
1035.	1469.	1826.	2005.	1963.	1758.	1497.	1247.	1035.	859.
712.	590.	487.	402.	332.	274.	226.	187.	154.	127.
105.	86.	71.	59.	48.	39.	32.	25.	19.	13.
6.	5.	5.	4.	4.	3.	3.	3.	2.	2.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.

1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2110.	1826.	859.	305.	21990.
CMS	60.	52.	24.	9.	623.
INCHES		3.61	6.80	7.24	7.25
MM		91.78	172.83	184.02	184.25
AC-FT		905.	1705.	1815.	1817.
THOUS CU M		1117.	2103.	2239.	2242.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 7

2.	2.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	3.	3.	5.	9.	18.	31.	44.	54.
57.	53.	45.	38.	32.	27.	23.	20.	19.	17.
19.	30.	51.	82.	119.	154.	204.	309.	501.	849.
1352.	1933.	2402.	2638.	2583.	2313.	1970.	1641.	1362.	1130.
937.	776.	641.	529.	437.	365.	297.	245.	202.	167.
138.	114.	93.	77.	63.	52.	43.	33.	25.	18.
7.	7.	6.	5.	5.	4.	4.	3.	3.	3.
2.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2638.	2292.	1074.	381.	27465.
CMS	75.	65.	30.	11.	778.
INCHES		4.52	8.51	9.06	9.07
MM		114.73	216.03	230.03	230.31
AC-FT		1132.	2131.	2269.	2272.
THOUS CU M		1396.	2628.	2799.	2802.

HYDROGRAPH AT STA BSN-3 FOR PLAN 1, RTIO 8

4.	4.	4.	4.	3.	3.	3.	3.	4.	4.
4.	5.	6.	7.	10.	17.	35.	61.	89.	108.
114.	105.	91.	76.	63.	53.	46.	41.	37.	35.
39.	59.	102.	164.	237.	308.	409.	617.	1002.	1697.
2725.	3867.	4805.	5275.	5166.	4625.	3940.	3282.	2724.	2261.
1875.	1552.	1283.	1059.	874.	721.	595.	491.	405.	334.
276.	227.	187.	154.	126.	104.	85.	65.	50.	36.
15.	13.	12.	11.	10.	9.	8.	7.	6.	6.
5.	4.	4.	4.	3.	3.	3.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	1.	1.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5275.	4564.	2149.	763.	54976.
CMS	149.	129.	61.	22.	1557.
INCHES		9.03	17.01	18.11	18.13
MM		229.45	432.07	460.06	460.62
AC-FT		2263.	4262.	4538.	4543.
THOUS CU M		2792.	5257.	5597.	5604.

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COMBINE HYDROGRAPHS

COMBINED HYDROGRAPHS AT DAM -- SUBBASINS 1-2-3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	3	0	0	0	0	1	0	0

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1, RTIO 1

THOUS CU M 2772. 5247. 5597. 5604.

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COMBINE HYDROGRAPHS

COMBINED HYDROGRAPHS AT DAM -- SUBBASINS 1-2-3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	3	0	0	0	0	1	0	0

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIO 1

4.	3.	3.	3.	3.	3.	2.	2.	2.	2.
3.	3.	3.	4.	5.	10.	25.	48.	72.	88.
79.	61.	68.	56.	46.	38.	32.	27.	24.	21.
25.	47.	90.	150.	219.	230.	373.	577.	959.	1645.
2639.	3704.	4515.	4814.	4557.	3965.	3302.	2703.	2211.	1809.
1473.	1207.	963.	801.	652.	531.	433.	353.	287.	234.
191.	155.	126.	101.	81.	64.	46.	36.	27.	18.
11.	9.	8.	8.	7.	6.	5.	5.	4.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4814.	4086.	1865.	656.	47256.
CMS	136.	116.	53.	19.	1338.
INCHES		3.27	5.96	6.29	6.29
MM		82.98	151.43	159.71	159.87
AC-FT		2027.	3699.	3901.	3905.
THOUS CU M		2500.	4563.	4812.	4817.

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIO 2

4.	4.	3.	3.	3.	3.	2.	2.	2.	3.
3.	3.	3.	4.	5.	11.	26.	50.	74.	90.
92.	83.	70.	57.	47.	39.	33.	28.	25.	22.
26.	48.	92.	155.	224.	288.	384.	594.	987.	1692.
2714.	3810.	4644.	4952.	4690.	4079.	3396.	2780.	2274.	1860.
1521.	1241.	1011.	824.	671.	546.	445.	363.	295.	241.
196.	160.	130.	104.	83.	65.	47.	37.	28.	19.
11.	10.	9.	8.	7.	6.	6.	5.	4.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4952.	4205.	1918.	674.	48606.
CMS	140.	119.	54.	19.	1376.
INCHES		3.36	6.13	6.47	6.47
MM		85.35	155.75	164.27	164.44
AC-FT		2085.	3805.	4013.	4017.
THOUS CU M		2572.	4693.	4950.	4955.

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIO 3

4.	4.	3.	3.	3.	3.	3.	2.	2.	3.
3.	3.	3.	4.	5.	11.	27.	51.	76.	93.
95.	85.	72.	59.	48.	40.	34.	29.	25.	22.
27.	49.	95.	159.	230.	296.	394.	610.	1014.	1739.
2790.	3915.	4773.	5089.	4820.	4192.	3491.	2858.	2337.	1912.
1563.	1276.	1040.	847.	689.	562.	458.	373.	304.	247.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CMS	[illegible]	[illegible]	53.	19.	1338.
INCHES		3.27	5.96	6.29	6.29
MM		82.98	151.43	159.71	159.87
AC-FT		2027.	3699.	3901.	3905.
THOUS CU M		2500.	4563.	4812.	4817.

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIC 2

4.	4.	3.	3.	3.	3.	2.	2.	2.	3.
3.	3.	3.	4.	5.	11.	26.	50.	74.	90.
92.	83.	70.	57.	47.	39.	32.	28.	25.	22.
26.	48.	92.	155.	224.	258.	384.	594.	987.	1692.
2714.	3810.	4644.	4952.	4690.	4079.	3396.	2780.	2274.	1860.
1521.	1241.	1011.	824.	671.	546.	445.	363.	295.	241.
196.	160.	130.	104.	83.	65.	47.	37.	28.	19.
11.	10.	9.	8.	7.	6.	6.	5.	4.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4952.	4265.	1918.	674.	48606.
CMS	140.	119.	54.	19.	1376.
INCHES		3.36	6.13	6.47	6.47
MM		85.35	155.75	164.27	164.44
AC-FT		2085.	3805.	4013.	4017.
THOUS CU M		2572.	4693.	4950.	4955.

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIC 3

4.	4.	3.	3.	3.	3.	3.	2.	2.	3.
3.	3.	3.	4.	5.	11.	27.	51.	76.	93.
95.	85.	72.	59.	48.	40.	34.	29.	25.	22.
27.	49.	95.	159.	230.	296.	394.	610.	1014.	1739.
2790.	3915.	4773.	5039.	4820.	4192.	3491.	2858.	2337.	1912.
1563.	1276.	1040.	847.	689.	562.	458.	373.	304.	247.
202.	164.	133.	107.	85.	67.	48.	38.	29.	19.
11.	10.	9.	9.	7.	6.	6.	5.	5.	4.
4.	3.	3.	3.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5089.	4322.	1972.	693.	49956.
CMS	144.	122.	56.	20.	1415.
INCHES		3.45	6.30	6.65	6.65
MM		87.72	160.08	168.83	169.01
AC-FT		2143.	3910.	4124.	4129.
THOUS CU M		2643.	4823.	5087.	5093.

SUM OF 3 HYDROGRAPHS AT DAM PLAN 1 RTIC 4

4.	4.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	3.	4.	5.	11.	28.	52.	78.	95.
97.	86.	74.	60.	50.	41.	34.	30.	26.	23.
28.	51.	97.	163.	237.	304.	405.	627.	1042.	1786.
2865.	4021.	4902.	5227.	4950.	4305.	3585.	2935.	2400.	1964.
1605.	1310.	1068.	869.	709.	577.	470.	383.	312.	254.
207.	158.	137.	110.	88.	69.	50.	39.	30.	20.
11.	10.	9.	8.	7.	7.	6.	5.	5.	4.
4.	3.	3.	3.	2.	2.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	0.

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

```
  12.       11.       10.        9.        8.        7.        6.        6.        5.        4.
   4.        4.        3.        3.        3.        2.        2.        2.        2.        1.
   1.        1.        1.        1.        1.        1.        1.        1.        1.        0.

                        PEAK    6-HOUR   24-HOUR   72-HOUR    TOTAL VOLUME
              CFS      5502.     4672.     2131.      749.         54007.
              CMS       156.      132.       60.       21.          1529.
           INCHES                 3.73      6.81      7.19           7.19
               MM                94.84    173.06    182.52         182.71
            AC-FT                2317.     4227.     4459.          4463.
       THOUS CU M                2858.     5215.     5500.          5505.


                  SUM OF 3 HYDROGRAPHS AT     DAM  PLAN 1  RTIO 7
   5.        5.        4.        4.        4.        4.        3.        3.        3.        4.
   4.        4.        4.        5.        7.       15.       36.       69.      103.      125.
 128.      115.       97.       80.       65.       54.       45.       39.       34.       30.
  34.       67.      128.      215.      311.      400.      533.      825.     1370.     2351.
3770.     5291.     6450.     6878.     6513.     5665.     4717.     3862.     3158.     2584.
2112.     1724.     1405.     1144.      932.      759.      618.      504.      410.      334.
 272.      222.      180.      145.      115.       91.       65.       51.       39.       26.
  15.       13.       12.       11.       10.        9.        8.        7.        6.        6.
   5.        4.        4.        4.        3.        3.        3.        2.        2.        2.
   2.        1.        1.        1.        1.        1.        1.        1.        1.        1.

                        PEAK    6-HOUR   24-HOUR   72-HOUR    TOTAL VOLUME
              CFS      6878.     5840.     2664.      937.         67508.
              CMS       195.      165.       75.       27.          1912.
           INCHES                 4.67      8.52      8.98           8.99
               MM               118.55    216.32    228.15         228.39
            AC-FT                2696.     5284.     5573.          5579.
       THOUS CU M                3572.     6518.     6875.          6882.


                  SUM OF 3 HYDROGRAPHS AT     DAM  PLAN 1  RTIO 8
  11.       10.        9.        8.        8.        7.        7.        7.        7.        7.
   7.        8.        9.       10.       14.       30.       72.      138.      206.      251.
 257.      231.      194.      159.      130.      108.       91.       78.       68.       61.
  73.      133.      256.      430.      623.      800.     1066.     1650.     2741.     4701.
7540.    10582.    12899.    13755.    13026.    11329.     9435.     7723.     6317.     5167.
4224.     3448.     2810.     2268.     1663.     1518.     1237.     1008.      821.      669.
 545.      443.      360.      289.      231.      182.      130.      102.       78.       53.
  30.       27.       24.       22.       19.       17.       16.       14.       12.       11.
  10.        9.        8.        7.        6.        6.        5.        5.        4.        4.
   3.        3.        3.        2.        2.        2.        2.        2.        1.        1.

                        PEAK    6-HOUR   24-HOUR   72-HOUR    TOTAL VOLUME
              CFS     13755.    11680.     5328.     1873.        135017.
              CMS       390.      331.      151.       53.          3823.
           INCHES                 9.33     17.03     17.96          17.98
               MM               237.09    432.64    456.31         456.78
            AC-FT                5792.    10569.    11147.         11158.
       THOUS CU M                7144.    13036.    13749.         13764.


**********          **********          **********          **********          **********

                              HYDROGRAPH ROUTING

                ROUTED OUTFLOW - DAM - SPILLCREST ELEV 100-PLAN  --  1316.9-USGS
                   ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
```

```
              12           237.09    432.54    456.31     456.78
           AC-FT            5792.    10569.    11147.     11150.
        THOUS CU M          7144.    13036.    13749.     13764.


   **********        **********        **********        **********        **********

                                 HYDROGRAPH ROUTING

               ROUTED OUTFLOW - DAM - SPILLCREST ELEV 10C-PLAN  --  1316.9-USGS
                      ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                        DAM       1       0       0       0       C       1       0       0
                                             ROUTING DATA
               QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                  0.      0.      0.       1       1       0       C               0

                      NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                          1       0       0      0.      0.      C.   -100.      -1

STAGE      100.00     101.00     102.00     103.00     104.00     105.00     106.00

FLOW          0.      310.00     877.00    1611.00    2480.00    3466.00    4556.00

 CAPACITY=        C.      194.      355.      580.      869.     1214.     1648.     2194.     2322.     2837.

 ELEVATION=      55.       75.       80.       85.       90.       95.      100.      105.      106.      110.

                      CREL   SPWID    COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                     100.0      0.      0.      0.      0.      C.      0.      0.

                                          DAM DATA
                                  TOPEL    COQD    EXPD  DAMWID
                                  106.0     2.6     1.5   1110.

                              STATION    DAM, PLAN 1, RATIO 1

                              END-OF-PERIOD HYDROGRAPH ORDINATES

                                            OUTFLOW
            1.        1.        2.        2.        2.        2.        2.        2.        2.        2.
            2.        2.        3.        3.        3.        4.        7.       13.       23.       35.
           46.       54.       59.       59.       57.       54.       50.       46.       42.       38.
           35.       35.       42.       58.       85.      119.      163.      228.      363.      655.
         1282.     2171.     3193.     3963.     4342.     4300.     3954.     3460.     2915.     2428.
         2040.     1695.     1424.     1193.      990.      828.      706.      595.      498.      414.
          343.      294.      262.      231.      201.      174.      149.      127.      107.       89.
           73.       60.       49.       41.       34.       28.       23.       19.       16.       14.
           12.       10.        8.        7.        6.        5.        5.        4.        4.        3.
            3.        2.        2.        2.        2.        1.        1.        1.        1.        1.

                                            STORAGE
         1648.     1648.     1648.     1648.     1648.     1648.     1648.     1648.     1648.     1648.
         1648.     1648.     1646.     1648.     1649.     1649.     1650.     1652.     1656.     1660.
         1664.     1667.     1668.     1663.     1664.     1667.     1665.     1664.     1662.     1661.
         1660.     1660.     1662.     1668.     1677.     1690.     1705.     1728.     1767.     1831.
         1926.     2046.     2164.     2253.     2297.     2292.     2251.     2193.     2133.     2078.
         2029.     1986.     1948.     1913.     1863.     1857.     1833.     1812.     1793.     1777.
         1763.     1751.     1740.     1729.     1719.     1709.     1700.     1692.     1685.     1679.
         1673.     1669.     1665.     1662.     1659.     1657.     1656.     1654.     1653.     1652.
         1652.     1651.     1650.     1650.     1650.     1649.     1649.     1649.     1649.     1649.
         1648.     1648.     1643.     1648.     1643.     1648.     1648.     1648.     1648.     1648.
```

INCHES	3.07	5.87	6.29		6.29
MM	78.08	149.07	159.66		159.88
AC-FT	1967.	3642.	3901.		3906.
THOUS CU M	2353.	4492.	4811.		4817.

STATION DAM, PLAN 1, RATIO 2

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	3.	3.	3.	3.	4.	7.	14.	24.	36.
48.	56.	60.	61.	59.	56.	52.	47.	43.	39.
36.	36.	43.	60.	87.	123.	167.	235.	380.	718.
1327.	2245.	3298.	4034.	4466.	4424.	4068.	3559.	3003.	2495.
2096.	1742.	1459.	1223.	1017.	847.	723.	610.	511.	425.
352.	295.	266.	235.	205.	179.	152.	129.	109.	91.
75.	61.	50.	42.	34.	29.	24.	20.	17.	14.
12.	10.	9.	7.	6.	6.	5.	4.	4.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.

STORAGE

1648.	1648.	1648.	1648.	1649.	1648.	1648.	1648.	1648.	1648.
1648.	1648.	1648.	1648.	1649.	1649.	1650.	1652.	1656.	1660.
1664.	1667.	1669.	1669.	1668.	1667.	1666.	1664.	1663.	1661.
1660.	1660.	1663.	1669.	1678.	1691.	1706.	1730.	1770.	1836.
1933.	2055.	2175.	2267.	2312.	2307.	2265.	2205.	2143.	2066.
2036.	1992.	1953.	1918.	1887.	1860.	1836.	1815.	1796.	1779.
1765.	1753.	1741.	1730.	1720.	1710.	1701.	1693.	1686.	1680.
1674.	1665.	1665.	1662.	1660.	1658.	1656.	1655.	1653.	1652.
1652.	1651.	1651.	1650.	1650.	1649.	1649.	1649.	1649.	1649.
1643.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.

STAGE

100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.1
100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.1	100.1
100.1	100.1	100.1	100.2	100.3	100.4	100.5	100.8	101.1	101.7
102.6	103.7	104.8	105.6	105.9	105.9	105.6	105.1	104.5	104.0
103.5	103.3	102.9	102.5	102.2	101.9	101.7	101.5	101.4	101.2
101.1	101.0	100.9	100.8	100.7	100.6	100.5	100.4	100.4	100.3
100.2	100.2	100.2	100.1	100.1	100.1	100.1	100.1	100.1	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PEAK OUTFLOW IS 4466. AT TIME 45.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4466.	3959.	1889.	674.	48607.
CMS	126.	112.	53.	19.	1376.
INCHES		3.16	6.04	6.47	6.47
MM		80.36	153.38	164.24	164.45
AC-FT		1963.	3747.	4012.	4017.
THOUS CU M		2421.	4622.	4949.	4955.

STATION DAM, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	4.	7.	14.	24.	37.
49.	58.	62.	63.	61.	57.	53.	48.	44.	40.

INCHES	3.16	6.04	6.47		6.47
MM	80.36	153.38	164.24		164.45
AC-FT	1963.	3747.	4012.		4017.
THOUS CU M	2421.	4622.	4949.		4955.

STATION DAM, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
3.	3.	3.	3.	3.	4.	7.	14.	24.	37.
49.	58.	62.	63.	61.	57.	53.	48.	44.	40.
37.	37.	44.	62.	90.	126.	172.	241.	396.	742.
1373.	2319.	3403.	4199.	4602.	4541.	4178.	3657.	3090.	2566.
2143.	1788.	1492.	1254.	1043.	864.	739.	625.	524.	436.
351.	303.	271.	239.	209.	181.	155.	132.	111.	93.
77.	63.	52.	43.	35.	29.	24.	20.	17.	14.
12.	10.	9.	8.	7.	6.	5.	4.	4.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.

STORAGE

1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.
1648.	1648.	1648.	1649.	1649.	1649.	1650.	1652.	1656.	1661.
1665.	1668.	1669.	1670.	1669.	1668.	1666.	1665.	1663.	1661.
1660.	1660.	1663.	1669.	1677.	1692.	1708.	1733.	1773.	1840.
1940.	2064.	2187.	2280.	2326.	2321.	2278.	2216.	2152.	2094.
2043.	1978.	1956.	1922.	1891.	1864.	1839.	1817.	1798.	1781.
1767.	1754.	1743.	1732.	1721.	1711.	1702.	1694.	1687.	1680.
1675.	1670.	1666.	1663.	1660.	1658.	1656.	1655.	1654.	1653.
1652.	1651.	1651.	1650.	1650.	1649.	1649.	1649.	1649.	1649.
1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.	1648.

STAGE

100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.1
100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.2	100.1	100.1
100.1	100.1	100.1	100.2	100.3	100.4	100.6	100.8	101.2	101.8
102.7	103.3	104.9	105.7	106.0	106.0	105.7	105.2	104.6	104.1
103.6	103.2	102.8	102.5	102.2	102.0	101.8	101.6	101.4	101.2
101.1	101.0	100.9	100.8	100.7	100.6	100.5	100.4	100.4	100.3
100.2	100.2	100.2	100.1	100.1	100.1	100.1	100.1	100.1	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PEAK OUTFLOW IS 4602. AT TIME 45.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4602.	4071.	1942.	693.	49957.
CMS	130.	115.	55.	20.	1415.
INCHES		3.25	6.21	6.65	6.65
MM		82.63	157.70	168.80	169.01
AC-FT		2018.	3852.	4124.	4129.
THOUS CU M		2490.	4752.	5086.	5093.

STATION DAM, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	1.	2.	2.	2.	2.	3.	3.	3.	3.
3.	3.	3.	3.	3.	4.	7.	14.	25.	38.
59.	59.	64.	64.	62.	59.	54.	50.	45.	41.

PEAK OUTFLOW IS 5232. AT TIME 45.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5232.	4414.	2102.	749.	54007.
CMS	150.	125.	60.	21.	1529.
INCHES		3.53	6.72	7.18	7.19
MM		89.60	170.65	182.49	182.71
AC-FT		2189.	4169.	4458.	4463.
THOUS CU M		2700.	5142.	5499.	5506.

STATION DAM, PLAN 1, RATIO 7

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

1.	2.	3.	3.	3.	3.	3.	3.	3.	3.
3.	3.	4.	4.	4.	6.	10.	19.	33.	50.
66.	78.	84.	85.	82.	77.	72.	65.	59.	54.
49.	50.	60.	83.	121.	170.	232.	337.	606.	1088.
1991.	3223.	4695.	6822.	6674.	5994.	5126.	4455.	3964.	3394.
2826.	2346.	1959.	1620.	1366.	1140.	944.	796.	676.	569.
475.	395.	326.	285.	253.	221.	191.	163.	139.	116.
96.	79.	63.	54.	45.	37.	31.	26.	22.	19.
16.	14.	12.	10.	9.	7.	6.	6.	5.	4.
4.	3.	3.	3.	2.	2.	2.	2.	1.	1.

STORAGE

1648.	1648.	1648.	1649.	1649.	1649.	1649.	1649.	1649.	1649.
1649.	1649.	1649.	1649.	1649.	1650.	1651.	1654.	1659.	1665.
1671.	1675.	1677.	1677.	1676.	1675.	1673.	1671.	1668.	1666.
1665.	1665.	1669.	1677.	1690.	1708.	1729.	1762.	1814.	1898.
2023.	2178.	2332.	2407.	2403.	2382.	2352.	2310.	2253.	2186.
2123.	2068.	2019.	1977.	1939.	1905.	1876.	1850.	1827.	1807.
1789.	1773.	1760.	1748.	1737.	1725.	1715.	1705.	1696.	1689.
1681.	1675.	1670.	1667.	1663.	1661.	1658.	1657.	1655.	1654.
1653.	1652.	1652.	1651.	1651.	1650.	1650.	1649.	1649.	1649.
1649.	1649.	1649.	1648.	1648.	1648.	1648.	1648.	1648.	1648.

STAGE

100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.1	100.2
100.2	100.3	100.3	100.3	100.3	100.2	100.2	100.2	100.2	100.2
100.2	100.2	100.2	100.3	100.4	100.5	100.7	101.0	101.5	102.3
103.4	104.9	106.1	106.7	106.6	106.5	106.2	105.9	105.5	104.9
104.4	103.8	103.4	103.0	102.7	102.4	102.1	101.9	101.6	101.5
101.3	101.1	101.0	100.9	100.8	100.7	100.6	100.5	100.4	100.4
100.3	100.3	100.2	100.2	100.1	100.1	100.1	100.1	100.1	100.1
100.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PEAK OUTFLOW IS 6822. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6822.	5567.	2634.	936.	67511.
CMS	193.	158.	75.	27.	1912.
INCHES		4.45	8.42	8.98	8.99
MM		113.00	213.86	228.12	228.40
AC-FT		2760.	5224.	5572.	5579.
THOUS CU M		3405.	6444.	6874.	6882.

STATION DAM, PLAN 1, RATIO 8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CMS	193.	155.	75.	27.	1912.
INCHES		4.45	8.42	8.98	8.99
MM		113.00	213.86	228.12	228.40
AC-FT		2760.	5224.	5573.	5579.
THOUS CU M		3405.	6444.	6874.	6882.

STATION DAM, PLAN 1, RATIO 8

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

2.	4.	5.	6.	6.	7.	7.	7.	7.	7.
7.	7.	7.	8.	9.	11.	20.	33.	66.	100.
132.	156.	167.	169.	164.	155.	143.	131.	119.	107.
99.	100.	120.	166.	242.	351.	563.	844.	1423.	2539.
4439.	9646.	12449.	13656.	13292.	11770.	9918.	8152.	6751.	5594.
4697.	4206.	3647.	3059.	2525.	2108.	1747.	1459.	1222.	1015.
845.	721.	608.	508.	421.	345.	291.	254.	220.	187.
157.	130.	108.	90.	76.	64.	54.	46.	39.	33.
28.	24.	21.	18.	15.	14.	12.	11.	9.	8.
7.	6.	6.	5.	4.	4.	3.	3.	3.	2.

STORAGE

1648.	1649.	1649.	1650.	1650.	1650.	1650.	1650.	1650.	1650.
1650.	1650.	1650.	1650.	1651.	1652.	1654.	1661.	1671.	1683.
1624.	1702.	1707.	1707.	1705.	1732.	1698.	1654.	1689.	1685.
1682.	1683.	1690.	1706.	1733.	1757.	1806.	1860.	1947.	2091.
2309.	2475.	2533.	2555.	2549.	2519.	2481.	2442.	2405.	2369.
2332.	2261.	2215.	2149.	2090.	2038.	1992.	1953.	1917.	1887.
1860.	1836.	1814.	1795.	1773.	1753.	1750.	1737.	1725.	1714.
1703.	1693.	1686.	1679.	1674.	1670.	1666.	1664.	1661.	1659.
1658.	1656.	1655.	1654.	1653.	1652.	1652.	1651.	1651.	1650.
1650.	1650.	1649.	1649.	1647.	1649.	1649.	1649.	1648.	1648.

STAGE

100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.1	100.1	100.2	100.3
100.4	100.5	100.5	100.5	100.5	100.5	100.5	100.4	100.4	100.3
100.3	100.3	100.4	100.5	100.8	101.1	101.4	101.9	102.7	104.1
105.9	107.2	107.6	107.8	107.8	107.5	107.2	106.9	106.6	106.4
106.1	105.7	105.2	104.6	104.0	103.6	103.2	102.8	102.5	102.2
101.9	101.7	101.5	101.3	101.2	101.1	100.9	100.8	100.7	100.6
100.5	100.4	100.3	100.3	100.2	100.2	100.2	100.1	100.1	100.1
100.1	100.1	100.1	100.1	100.1	100.0	100.0	100.0	100.0	100.0
100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

PEAK OUTFLOW IS 13656. AT TIME 44.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13656.	11667.	5291.	1873.	135019.
CMS	387.	330.	150.	53.	3823.
INCHES		9.32	16.91	17.96	17.98
MM		236.83	429.59	456.23	456.79
AC-FT		5785.	10494.	11145.	11159.
THOUS CU M		7136.	12944.	13747.	13764.

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FORMULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

				RATIOS APPLIED TO FLOWS							
OPERATION	STATION	AREA	PLAN	RATIO 1 0.35	RATIO 2 0.36	RATIO 3 0.37	RATIO 4 0.38	RATIO 5 0.39	RATIO 6 0.40	RATIO 7 0.50	RATIO 8 1.00
HYDROGRAPH AT	BSN-1	4.83	1	2107.	2167.	2228.	2288.	2348.	2408.	3010.	6021.
		(13703.17)	(	59.67)(	61.37)(	63.08)(	64.78)(	66.49)(	68.19)(	85.24)(	170.48)(
HYDROGRAPH AT	BSN-2	2.11	1	861.	885.	910.	935.	959.	984.	1230.	2459.
		(13703.17)	(	24.38)(	25.07)(	25.77)(	26.47)(	27.16)(	27.86)(	34.82)(	69.65)(
HYDROGRAPH AT	BSN-3	4.70	1	1846.	1899.	1952.	2005.	2057.	2110.	2638.	5275.
		(13703.17)	(	52.28)(	53.78)(	55.27)(	56.76)(	58.26)(	59.75)(	74.69)(	149.38)(
3 COMBINED	DAM	11.64	1	4814.	4952.	5089.	5227.	5365.	5502.	6878.	13755.
		(13703.17)	(	136.33)(	140.22)(	144.12)(	148.01)(	151.91)(	155.80)(	194.75)(	389.51)(
ROUTED TO	DAM	11.64	1	4342.	4466.	4602.	4805.	5036.	5282.	6822.	13656.
		(13703.17)	(	122.94)(	126.48)(	130.30)(	136.06)(	142.62)(	149.57)(	193.17)(	386.71)(

MARTIN - DUNHAM RESERVOIR
NY-672

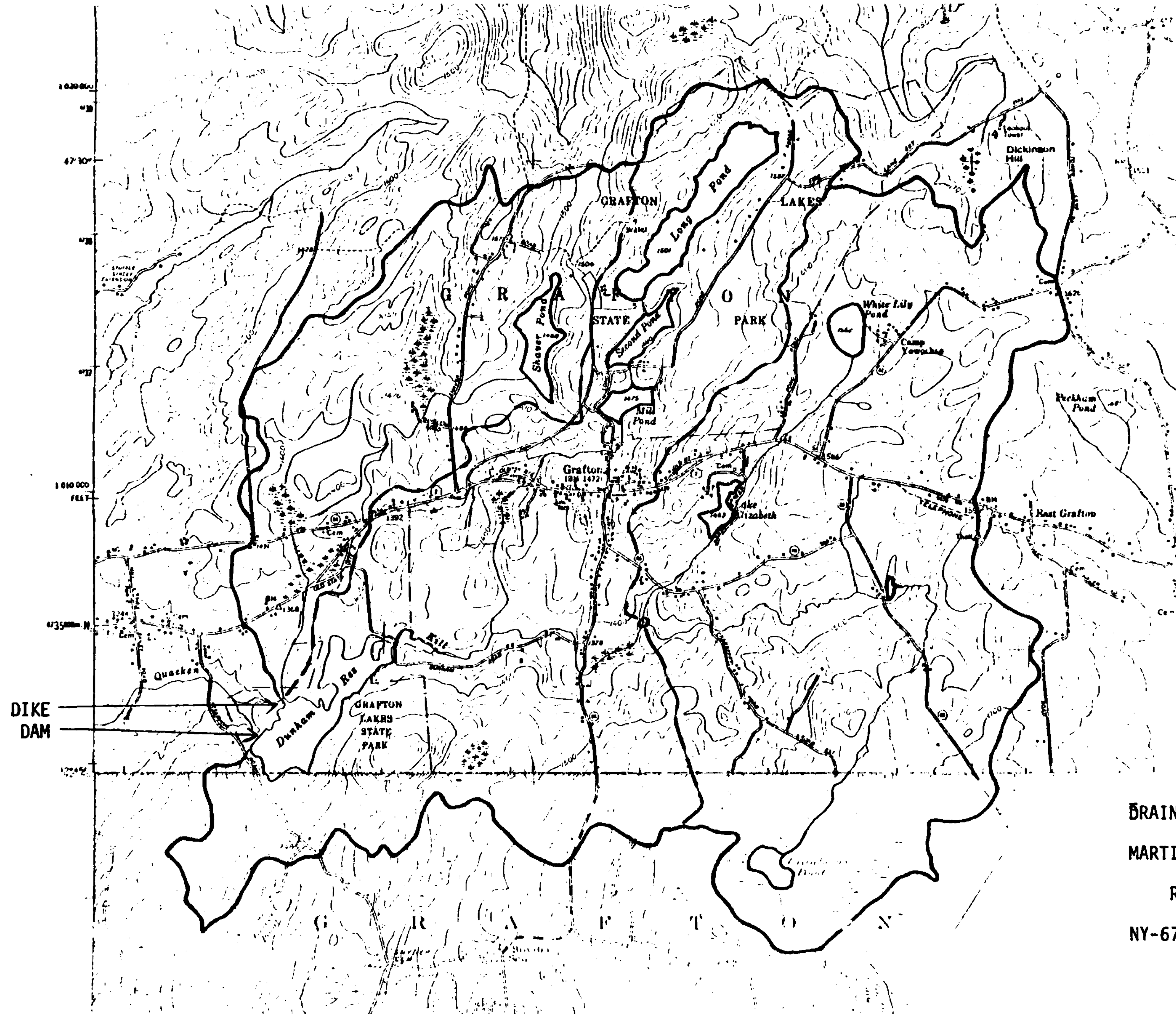
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	100.00	100.00	106.00
STORAGE	1648.	1648.	2322.
OUTFLOW	0.	0.	4556.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV.	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.35	105.80	0.	2297.	4342.	0.	45.00	0.
0.36	105.92	0.	2312.	4466.	0.	45.00	0.
0.37	106.03	0.03	2326.	4602.	1.00	45.00	0.
0.38	106.12	0.12	2338.	4805.	2.00	45.00	0.
0.39	106.20	0.20	2348.	5036.	2.00	45.00	0.
0.40	106.28	0.28	2358.	5282.	2.00	45.00	0.
0.50	106.66	0.66	2407.	6622.	5.00	44.00	0.
1.00	107.81	1.81	2555.	13656.	10.00	44.00	0.

MARTIN - DUNHAM RESERVOIR
NY-672

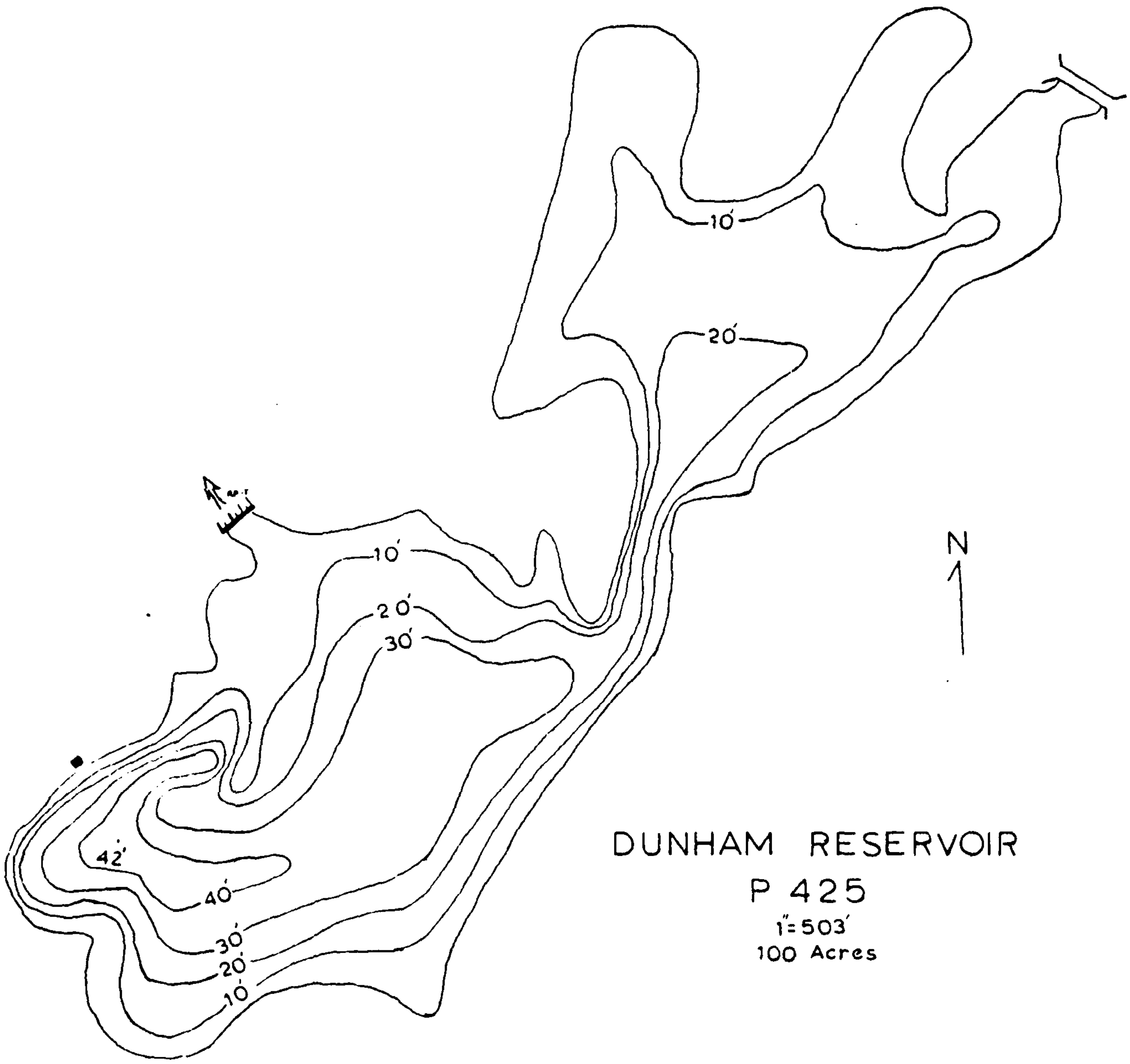


DRAINAGE AREA MAP

MARTIN - DUNHAM

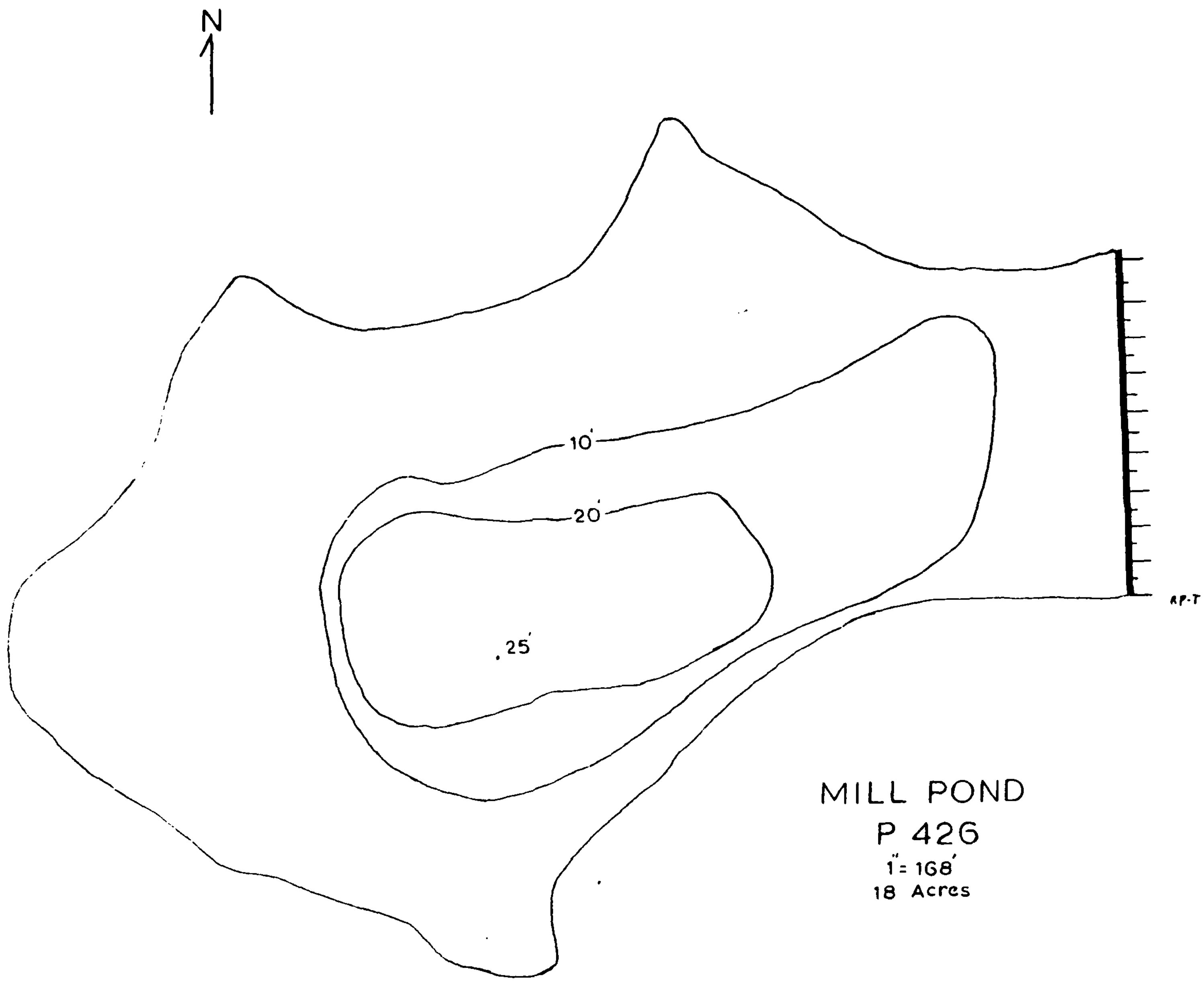
RESERVOIR

NY-672



DUNHAM RESERVOIR
P 425
1" = 503'
100 Acres

RENSSELAER COUNTY



MILL POND
P 426
1" = 168'
18 Acres

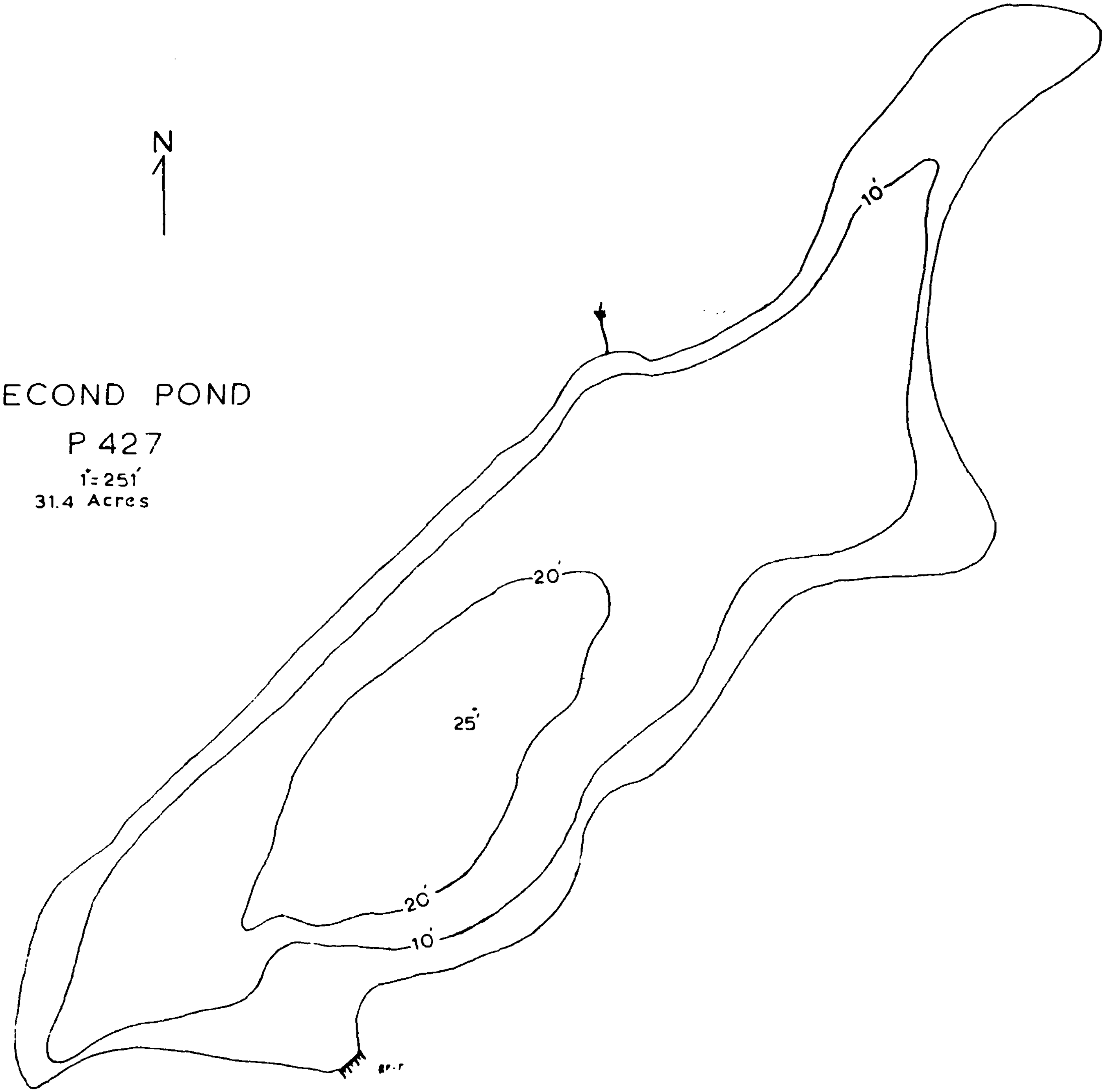
RENSSELAER COUNTY

SECOND POND

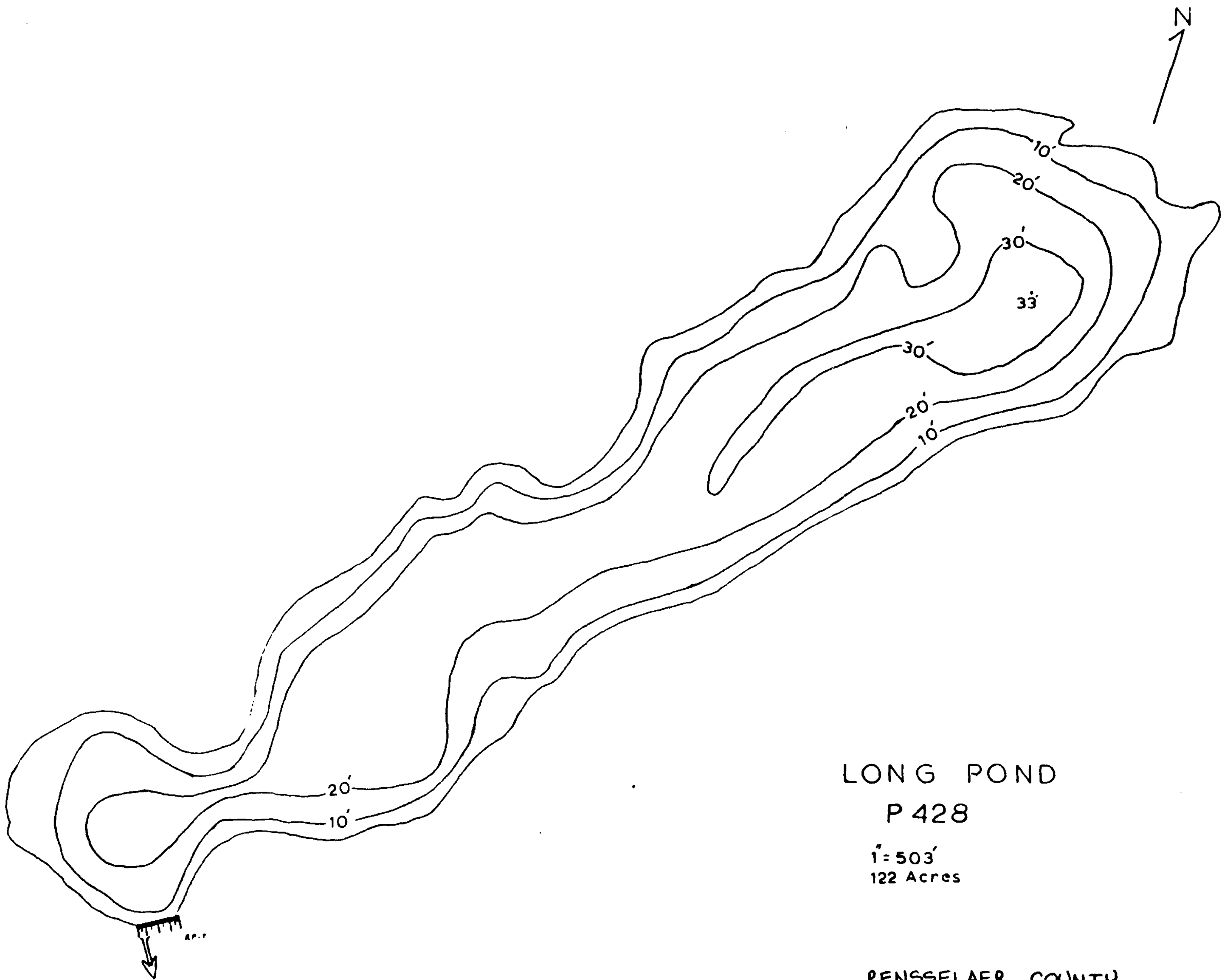
P 427

1" = 251'

31.4 Acres

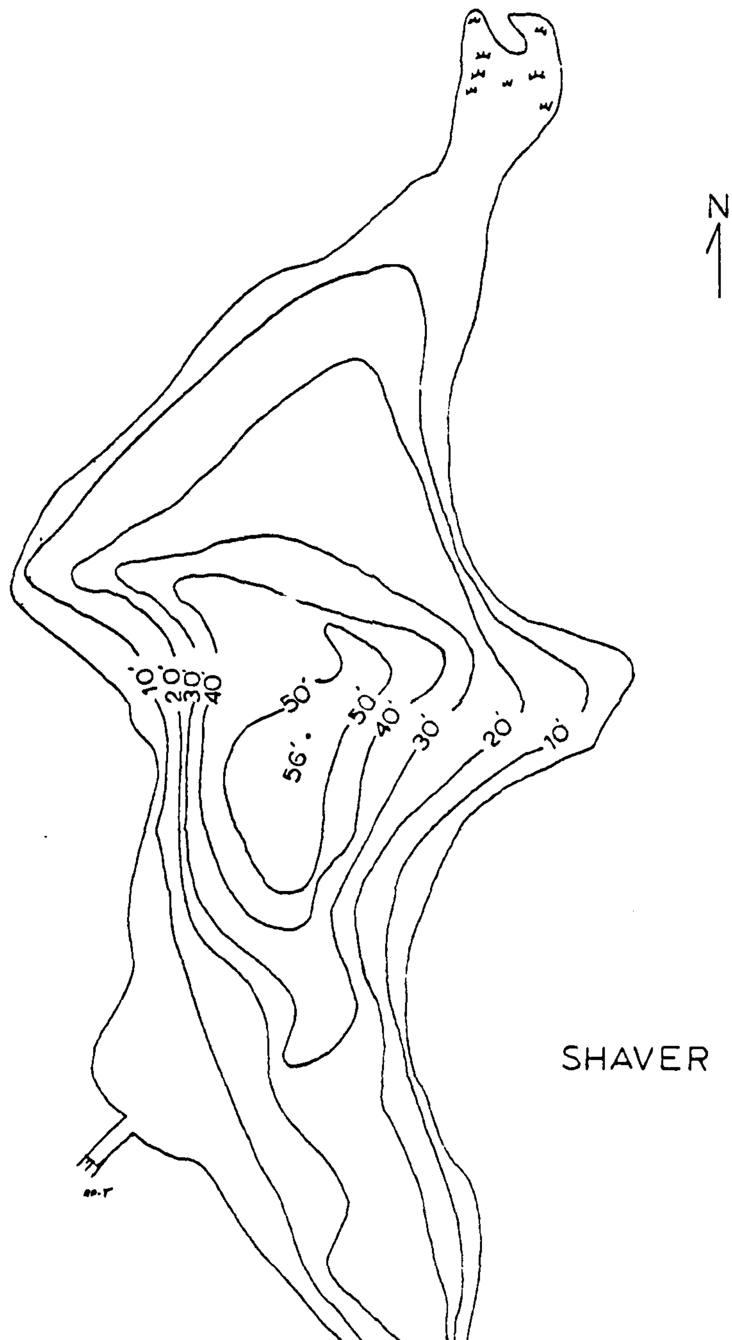


RENSSELAER COUNTY



LONG POND
P 428
1" = 503'
122 Acres

RENSSELAER COUNTY



SHAVER POND

RENSSELAER COUNTY

MARTIN - DUNHAM RESV.
NY-672

98. Quacken Kill at Quacken Kill, N. Y.[1]

Location.--Lat 42°46'10", long 73°31'15", just downstream from lower highway bridge in village of Quacken Kill, Rensselaer County, 3 miles southeast of Haynersville, and 6½ miles upstream from mouth.

Drainage area.--17.3 sq mi (revised).

Gage.--Staff gage and weir. Altitude of gage is 900 ft (from topographic map).

Remarks.--Some regulation by ponds above station.

Cooperation.--Records furnished by W. G. Raymond, consulting engineer, Department of Water Supply, Troy, N. Y.; records for January to December 1894 are revised and supersede those published in WSP 82.

Monthly and yearly mean discharge, in cubic feet per second

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1893	-	-	-	-	-	-	-	-	-	-	‡33.5	‡27.8	-
1894	‡15.4	‡11.8	‡38.4	*20.8	*8.58	*58.9	*28.9	*10.3	*7.01	*5.95	*6.80	*4.81	‡18.3
1895	*8.26	*28.4	*25.7	‡16.8	‡1.91	‡20.7	‡62.9	‡6.25	-	-	-	-	-

* Only monthly figures revised; revised daily figures not published.
‡ Not previously published.

Monthly and yearly runoff, in inches

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1893	-	-	-	-	-	-	-	-	-	-	‡2.23	‡1.79	-
1894	‡1.03	‡0.76	‡2.56	*1.39	*0.52	*3.92	*1.86	*0.69	*0.45	*0.40	*.44	*.31	‡14.35
1895	*.55	*1.83	*1.71	‡1.12	‡.11	‡1.38	‡4.05	‡.42	-	-	-	-	-

* Revised.
‡ Not previously published.

Yearly discharge, in cubic feet per second

Year	W.S.P. no.	Water year ending Sept. 30							Calendar year	
		Momentary maximum		Minimum day	Mean	Per square mile	Runoff in inches		Mean	Runoff in inches
		Discharge	Date							
1893	-	-	-	-	-	-	-		-	-
1894	-	-	-	*0.54	‡18.3	‡1.06	‡14.35		*17.9	*14.07
1895	-	-	-	-	-	-	-		-	-

* Revised.
‡ Not previously published.

99. Poesten Kill near Troy, N. Y.

Location.--Lat 42°44'00", long 73°38'00", on left bank 600 ft downstream from bridge on Troy-Eagle Mills road, a quarter of a mile downstream from Sweet Milk Creek, 1½ miles west of Eagle Mills, 3 miles east of Troy, Rensselaer County, and 5 miles upstream from mouth.

Drainage area.--89 sq mi, approximately.

Gage.--Water-stage recorder. Datum of gage is 321.46 ft above mean sea level (city of Troy, N. Y., datum). Prior to Sept. 22, 1938, at site 90 ft upstream at same datum.

Average discharge.--27 years (1923-50), 137 cfs.

Extremes.--1923-50: Maximum discharge, 11,900 cfs Sept. 22, 1938 (gage height, 12.1 ft, from floodmarks); minimum, 1.7 cfs Oct. 15, 1930.

Remarks.--Practically entire low flow of Quacken Kill, a tributary above station, diverted for municipal supply. Average annual diversion about 5 cfs.

Monthly and yearly mean discharge, in cubic feet per second

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1923	-	-	-	-	-	-	-	-	-	-	16.2	28.8	-
1924	93.6	306	321	259	28.4	122	528	157	35.3	12.6	12.1	73.4	162
1925	82.7	82.5	89.2	20.5	337	326	201	100	50	66.2	30.2	74.3	[illegible]
1926	104	257	74.8	88.5	111	263	496	91.9	58.2	12.0	68.2	12.8	136
1927	108	260	64.0	163	169	488	86.3	120	42.0	16.1	24.3	28.5	[illegible]
1928	162	626	351	203	207	179	324	184	269	167	185	121	247
1929	34.0	42.0	46.4	45.9	60.5	478	551	190	41.0	28.3	11.7	12.2	129
1930	9.69	22.4	43.0	129	147	258	127	91.5	112	19.5	7.10	7.26	60.7
1931	5.12	21.9	16.5	8.19	28.0	167	308	268	125	161	41.7	23.2	99.9
1932	16.8	26.0	119	252	123	84.8	481	80.0	29.9	28.5	26.0	13.3	[illegible]
1933	74.8	266	64.9	97.5	93.3	279	538	57.0	31.2	[illegible]	21.4	169	141
1934	120	93.0	176	192	34.2	340	475	143	134	[illegible]	12.5	23.6	144
1935	32.1	81.4	135	233	99.6	311	182	231	62.2	80.6	24.9	21.0	125
1936	12.6	116	108	163	59.3	737	242	115	23.3	7.30	26.0	18.0	[illegible]
1937	34.9	92.6	135	220	147	84.5	312	226	110	55.1	23.3	65.4	125
1938	110	143	[illegible]	230	184	218	165	111	52.8	262	112	628	194
1939	79.1	103	297	64.3	255	252	[illegible]	53.8	13.6	13.3	18.1	19.6	139
1940	37.4	149	75.1	41.7	29.7	250	771	190	62.2	[illegible]	46.4	118	156

[1] Published as Quackenkill Creek at Quackenkill Village, January to December 1902.

MARTIN - DUNHAM RESV.
NY-672

Monthly and yearly mean discharge, in cubic feet per second, of Poesten Kill near Troy, N. Y.--Con.

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1941	41.9	200	199	89.0	118	75.5	208	29.5	17.7	7.63	9.68	38.7	85.7
1942	15.2	30.0	95.3	86.4	39.7	348	240	71.9	78.7	121	46.2	52.4	103
1943	130	288	188	139	196	288	239	323	90.3	29.3	76.8	16.6	167
1944	37.3	190	93.0	32.1	53.6	303	390	85.3	92.8	54.3	26.4	42.2	116
1945	77.9	105	117	120	145	445	245	360	262	288	44.1	98.4	193
1946	112	211	171	157	78.2	323	98.1	283	197	30.1	31.7	37.1	145
1947	134	51.5	48.5	215	139	259	255	278	140	67.1	[illegible]	16.4	142
1948	12.5	89.1	47.6	34.4	156	457	203	268	155	34.0	[illegible]	12.9	174
1949	13.1	89.2	317	394	168	[illegible]	152	118	32.8	11.8	7.96	16.1	125
1950	16.5	34.6	98.9	192	107	298	248	118	122	19.9	108	290	137

Monthly and yearly runoff, in inches

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1923	-	-	-	-	-	-	-	-	-	-	‡0.21	‡0.36	-
1924	‡1.21	‡3.83	‡4.15	‡3.36	‡0.34	‡1.58	‡6.82	‡2.05	‡0.44	‡0.16	.16	‡.88	‡24.76
1925	1.07	1.03	1.16	.27	3.94	4.23	2.52	1.30	.63	.86	.39	.93	18.33
1926	1.35	3.23	.97	1.12	1.30	3.40	6.21	1.19	.73	.18	.88	.18	20.70
1927	1.39	3.25	.83	2.12	1.98	6.37	1.08	1.55	.53	.21	.31	.35	19.92
1928	2.10	7.84	4.55	2.62	2.51	2.32	4.06	2.38	3.38	2.17	2.37	1.52	37.82
1929	.44	.53	.60	.59	.71	6.19	6.90	2.46	.51	.37	[illegible]	.15	19.60
1930	.13	.28	.56	1.67	1.72	3.35	1.59	1.19	1.40	.25	.09	.09	12.32
1931	.07	.27	.21	.11	.33	2.17	3.86	3.74	1.56	2.09	.54	.29	15.24
1932	.22	.33	1.54	3.27	1.49	1.10	6.02	1.04	.37	.37	.34	.17	16.26
1933	.97	3.34	.84	1.27	1.09	3.61	6.74	.74	.39	.13	.28	2.12	21.52
1934	1.58	1.17	1.64	2.49	.40	4.40	5.96	1.86	1.68	.33	.16	.30	21.95
1935	.42	1.02	1.75	3.02	1.17	4.02	2.28	3.00	.78	1.04	.32	.26	19.08
1936	.16	1.45	1.40	2.11	.72	9.55	3.04	1.49	.29	.09	.34	.23	20.87
1937	.45	1.16	1.75	2.85	1.72	1.09	3.92	2.93	1.38	.71	.37	.82	19.08
1938	1.43	1.80	1.58	2.97	2.18	2.82	2.06	1.44	.66	3.39	1.45	7.88	29.64
1939	1.02	1.29	3.85	.83	2.99	3.26	6.38	.70	.17	.17	.23	.25	21.14
1940	.48	1.86	.97	.54	.36	3.24	9.66	2.48	.78	1.41	.63	1.48	23.87
1941	.54	2.51	2.58	1.15	1.38	.98	2.61	.38	.22	.10	.13	.49	13.07
1942	.20	.38	1.23	1.12	.46	4.51	3.01	.93	.96	1.57	.60	.78	15.75
1943	1.68	3.60	2.43	1.80	2.30	3.73	3.00	4.19	1.13	.38	.93	.21	25.44
1944	.48	2.38	1.20	.42	.65	3.92	4.89	1.10	1.16	.70	.34	.53	17.77
1945	1.01	1.32	1.52	1.55	1.69	5.76	3.07	4.66	3.29	3.73	.57	1.23	29.40
1946	1.46	2.64	2.21	2.03	.91	4.18	1.23	3.67	2.47	.39	.41	.46	22.06
1947	1.73	.65	.60	2.79	1.63	3.35	3.58	3.60	1.75	.97	.95	.21	21.62
1948	.16	1.12	.62	.45	1.90	5.32	2.54	3.45	1.95	.44	.26	.16	18.97
1949	.17	1.12	4.11	5.10	1.96	2.61	1.65	1.50	.41	.15	.10	.20	19.08
1950	.21	.43	1.26	2.48	1.25	3.86	1.10	1.51	1.51	.26	1.40	3.63	20.90

‡ Not previously published.

Yearly discharge, in cubic feet per second

Year	W.S.P. no.	Water year ending Sept. 30: Momentary maximum Discharge	Momentary maximum Date	Minimum day	Mean	Per square mile	Runoff in inches	Calendar year: Mean	Runoff in inches
1923	582	-	-	-	-	-	-	-	
1924	581	2,940	Dec. 1, 1923	4.7	162	‡1.82	‡24.76	123	‡18.83
1925	601	3,280	Feb. 12, 1925	5.7	120	1.35	18.33	135	20.61
1926	621	1,810	Nov. 16, 1925	4.7	136	1.53	20.70	135	20.67
1927	641	1,350	Mar. 14, 1927	5.7	131	1.47	19.92	190	29.34
1928	661	7,030	Nov. 4, 1927	-	247	2.78	37.82	163	24.90
1929	681	2,210	Mar. 14, 1929	2.2	129	1.45	19.60	125	[illegible]
1930	696	1,990	June 10, 1930	2.1	80.7	.907	12.32	78.0	11.92
1931	711	1,670	July 10, 1931	1.9	99.9	1.12	15.24	110	16.79
1932	726	2,150	Apr. 12, 1932	3.4	106	1.19	16.26	126	19.22
1933	741	1,990	Nov. 19, 1932	3.5	141	1.58	21.52	136	20.74
1934	756	1,760	Mar. 3, 1934	4.6	144	1.62	21.95	135	[illegible]
1935	781	2,080	Jan. 9, 1935	6.8	125	1.40	19.08	124	18.97
1936	801	4,750	Mar. 12, 1936	3.4	136	1.53	20.87	139	21.22
1937	821	1,480	May 15, 1937	6.1	125	1.40	19.08	134	20.53
1938	851	11,900	Sept.22, 1938	13	194	2.18	29.64	203	30.99
1939	871	3,330	Feb. 15, 1939	3.7	139	1.56	21.14	120	18.09
1940	891	4,320	Mar. 31, 1940	7.3	156	1.75	23.87	121	26.13
1941	921	1,200	Nov. 15, 1940	2.3	85.7	.963	13.07	60.6	9.25
1942	951	2,440	Mar. 17, 1942	3.9	103	1.16	15.75	142	21.65
1943	971	2,300	Dec. 31, 1942	9.1	167	1.88	25.44	143	21.79
1944	1001	1,920	Nov. 9, 1943	6.0	116	1.30	17.77	115	17.56
1945	1031	2,560	July 22, 1945	28	193	2.17	29.40	209	31.86
1946	1051	1,710	Mar. 7, 1946	10	145	1.63	22.06	123	18.73
1947	1081	2,120	Jan. 31, 1947	12	142	1.60	21.62	135	20.54
1948	1111	2,180	Mar. 16, 1948	9.6	124	1.39	18.97	147	22.47
1949	1141	10,100	Dec. 31, 1948	4.0	125	1.40	19.08	102	15.58
1950	1171	2,730	Sept. 1, 1950	9.3	137	1.54	20.90	-	-

‡ Not previously published.

MARTIN - DUNHAM RESV.
NY-672

3565. Poesten Kill near Troy, N. Y.

Location.--Lat 42°44'00", long 73°38'00", on left bank 600 ft downstream from bridge on State Highway 2, a quarter of a mile downstream from Sweet Milk Creek, 1½ miles west of Eagle Mills, 3 miles east of Troy, Rensselaer County, and 5 miles upstream from mouth.

Drainage area.--89 sq mi, approximately.

Records available.--July 1923 to September 1960.

Gage.--Water-stage recorder. Datum of gage is 301.46 ft above mean sea level (city of Troy, N. Y. datum). Prior to Sept. 22, 1938, at site 90 ft upstream at same datum.

Average discharge.--37 years (1923-60), 138 cfs.

Extremes.--1923-60: Maximum discharge, 11,900 cfs Sept. 22, 1938 (gage height, 12.1 ft, from floodmarks); minimum, 1.7 cfs Oct. 15, 1930.

Remarks.--Diversion from Quacken Kill, above station, for municipal supply returns to Poesten Kill below station, to Wynants Kill, and to Hudson River. Usable capacity of regulated ponds in Quacken Kill basin, 134,000,000 cu ft. Data prior to 1955 not available.

Monthly and yearly mean discharge, in cubic feet per second

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1951	59.7	171	233	176	283	303	331	68.5	40.2	111	85.5	60.7	159
1952	205	308	178	273	123	218	389	226	214	22.8	24.9	26.1	184
1953	17.8	18.1	116	223	181	389	438	384	39.5	13.8	15.2	13.6	154
1954	19.8	25.7	155	103	248	208	193	290	197	21.0	16.9	47.6	126
1955	41.5	194	224	84.4	157	306	290	55.5	41.8	12.4	32.5	20.1	121
1956	127	273	56.5	62.3	63.4	232	536	176	76.1	13.5	11.0	43.0	139
1957	29.6	124	189	97.2	63.4	145	198	127	55.6	23.2	13.9	18.0	90.4
1958	13.9	35.0	216	82.1	55.6	241	551	160	41.1	54.1	24.7	31.6	126
1959	83.9	178	85.1	81.2	63.8	191	339	107	30.8	15.5	15.6	12.9	100
1960	30.2	274	213	155	233	159	554	92.4	135	74.3	114	421	203

Monthly and yearly diversion, in cubic feet per second, from Quacken Kill

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
1951	-	-	-	-	-	-	-	-	-	-	-	-	-
1952	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	-	-	-	-	-	-	-	-	-	-	-	-
1954	-	-	-	-	-	-	-	-	-	-	-	-	-
1955	-	-	-	7.73	6.14	6.07	6.14	6.50	6.47	6.96	6.76	6.44	-
1956	5.26	6.55	6.60	4.95	5.00	5.32	5.00	5.00	5.04	5.10	5.68	6.12	5.49
1957	6.18	7.13	7.21	7.41	5.69	5.78	5.95	6.11	6.36	7.19	6.29	5.70	6.47
1958	6.05	6.47	6.40	5.66	5.82	6.00	5.39	6.20	5.61	7.38	6.87	6.77	[illegible]
1959	6.13	5.93	5.74	5.85	5.90	5.99	5.83	6.31	7.86	8.02	6.56	7.14	6.41
1960	7.30	6.95	5.39	5.63	5.98	5.71	5.25	5.38	5.81	5.41	5.59	6.18	5.36

Yearly discharge, in cubic feet per second

Year	WSP	Water year ending Sept. 30						Calendar year	
		Momentary maximum		Minimum day	Mean	Per square mile	Runoff in inches	Mean	Runoff in inches
		Discharge	Date						
1950	-	-	-	-	-	-	-	164	-
1951	1202	2,820	Nov. 26, 1950	11	159	-	-	178	-
1952	1232	3,430	June 1, 1952	8.3	184	-	-	138	-
1953	1272	2,600	Apr. 27, 1953	6.0	154	-	-	158	-
1954	1332	1,700	June 16, 1954	6.3	126	-	-	148	-
1955	1392	2,000	Feb. 23, 1955	4.0	121	-	-	121	-
1956	1432	2,480	Mar. 7, 1956	4.5	139	-	-	129	-
1957	1502	1,630	Jan. 23, 1957	6.6	90.4	-	-	84.1	-
1958	1552	2,080	Dec. 21, 1957	7.0	126	-	-	132	-
1959	1622	2,480	Apr. 3, 1959	4.4	100	-	-	114	-
1960	1702	5,040	Sept.12, 1960	9.1	203	-	-	-	-

Note.--Monthly and yearly figures of discharge per square mile and runoff in inches previously published in water-supply papers, may be in error because of diversion from Quacken Kill. Those figures are not published herein.

MARTIN - DUNHAM RESV.
NY - 672

HUDSON RIVER BASIN

1-3585. Poesten Kill near Troy, N. Y.

Location.--Lat 42°44'00", long 73°38'00", on left bank 600 ft downstream from bridge on State Highway 2, a quarter of a mile downstream from Sweet Milk Creek, 1 1/2 miles west of Eagle Mills, 3 miles east of Troy, Rensselaer County, and 5 miles upstream from mouth.

Drainage area.--89.4 sq mi.

Records available.--July 1923 to September 1968 (discontinued).

Gage.--Water-stage recorder. Datum of gage is 321.46 ft above mean sea level (city of Troy, N. Y., datum). Prior to Sept. 22, 1938, at site 90 ft upstream at same datum.

Average discharge.--45 years, 131 cfs.

Extremes.--Maximum discharge during year, 2,560 cfs Apr. 25 (gage height, 4.81 ft); minimum, 4.6 cfs Sept. 2 (gage height, 0.78 ft).
1923-68: Maximum discharge, 11,900 cfs Sept. 22, 1938 (gage height, 12.2 ft, from floodmarks); minimum, 0.6 cfs Sept. 24, 25, 1964 (gage height, 0.58 ft).

Remarks.--Records poor prior to Mar. 20 and fair thereafter. Diversion from Quacken Kill, a tributary above station, for municipal supply, returns to Poesten Kill below station, to Wynants Kill, or to Hudson River. Usable capacity of regulated ponds in Quacken Kill basin, 134,000,000 cu ft.

DISCHARGE, IN CFS, WATER YEAR OCTOBER 1967 TO SEPTEMBER 1968

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	[illegible]	140	134	55	250	30	302	154	67	151	10	5.8
2	[illegible]	120	115	56	350	31	302	131	59	160	13	5.2
3	12	150	154	58	500	32	214	134	[illegible]	118	13	5.5
4	11	194	291	60	400	32	190	190	72	89	11	5.8
5	10	230	250	50	300	33	205	160	[illegible]	73	9.7	5.2
6	[illegible]	170	230	54	240	33	190	137	47	55	9.7	5.8
7	9.3	134	214	52	210	33	160	110	[illegible]	44	10	7.6
8	[illegible]	118	255	50	190	34	145	95	[illegible]	42	9.3	9.7
9	[illegible]	105	240	47	150	35	137	87	[illegible]	[illegible]	8.9	9.3
10	27	102	210	45	130	40	118	102	51	30	9.7	9.3
11	149	102	190	42	110	54	107	91	206	24	9.3	17
12	91	105	772	40	94	64	98	120	137	35	8.2	56
13	[illegible]	157	1,280	39	84	50	89	160	* 115	23	[illegible]	37
14	47	142	875	39	72	52	80	124	[illegible]	19	[illegible]	23
15	[illegible]	120	567	38	66	58	75	102	[illegible]	17	6.1	19
16	33	100	362	38	60	110	71	89	137	16	6.4	16
17	28	91	270	37	52	350	64	118	187	14	8.9	14
18	27	98	202	37	46	1,000	59	120	[illegible]	13	9.5	12
19	34	124	160	37	41	1,200	54	143	152	59	7.6	12
20	40	112	145	37	37	1,150	50	214	[illegible]	65	7.9	11
21	40	93	128	37	33	1,090	47	230	250	52	[illegible]	11
22	38	91	148	37	32	931	47	183	160	25	[illegible]	11
23	[illegible]	163	157	37	31	1,180	42	140	123	20	9.7	10
24	33	280	123	39	30	1,370	105	131	[illegible]	18	9.5	10
25	40	318	96	40	30	632	1,800	112	[illegible]	21	8.2	11
26	400	346	74	41	29	450	827	91	234	20	7.3	13
27	310	335	64	46	29	368	463	76	302	16	7.0	13
28	250	265	62	50	29	324	335	66	330	14	6.7	12
29	210	206	60	56	29	291	235	67	273	13	6.4	11
30	190	157	58	90	------	250	187	93	194	12	6.4	11
31	160	------	56	220	------	198	------	78	------	11	6.4	------
TOTAL	2,372.5	4,872	7,942	1,611	3,644	11,565	6,799	3,892	4,354	1,305	268.5	399.2
MEAN	76.5	162	256	52.0	126	373	227	126	145	42.1	8.66	13.3
MAX	400	346	1,280	220	500	1,370	1,800	230	420	160	13	56
MIN	6.6	91	56	37	29	30	42	66	27	11	6.1	5.2
(≠)	.23	.23	.23	.23	.23	.23	.23	.31	.31	.31	.31	.31

CAL YR 1967 TOTAL 55,136.2 MEAN 151 MAX 1,500 MIN 7.9 ≠ 1.30
WTR YR 1968 TOTAL 49,024.3 MEAN 134 MAX 1,800 MIN 5.2 ≠ .26

PEAK DISCHARGE (BASE, 1,700 CFS)

DATE	TIME	G.HT.	DISCHARGE	DATE	TIME	G.HT.	DISCHARGE
3-24	0130	4.71	2,140	4-25	0330	4.81	2,560

≠ Diversion, in cubic feet per second, from Quacken Kill basin furnished by Troy water department.

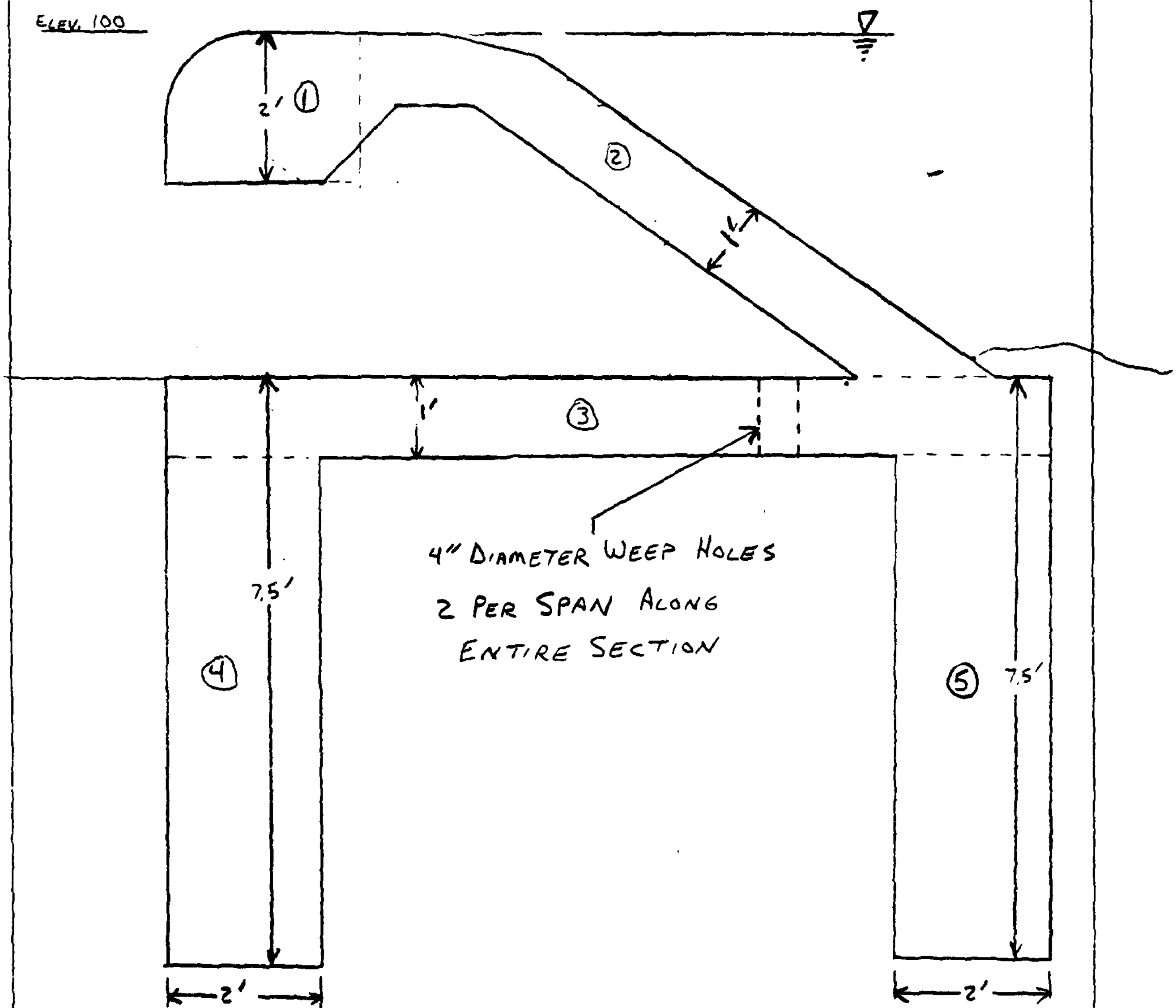
APPENDIX D

STABILITY COMPUTATIONS

MARTIN DUNHAM RESERVOIR DAM - SPILLWAY SECTION

DRAWING BASED ON FIELD MEASUREMENTS (11/13/81)

SCALE 1" = 2'



ASSUMPTIONS MADE FOR STABILITY ANALYSIS

1. IGNORE EFFECTS OF 2' PIERS SPACED 10 FEET ON CENTER UNDER SPILLWAY CREST

2. ASSUME THAT CUTOFF WALLS ARE BOTH CONTINUOUS FOR THE LENGTH OF THE STRUCTURE

3. ASSUME CUTOFF WALLS AND WEEP HOLES EFFECTIVELY REDUCE UPLIFT PRESSURES

00-15-1 (3/78)
Formerly GA-17

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN DUNHAM RESERVOIR DAM	1		
SUBJECT		COMPUTED BY	DATE
STRUCTURAL STABILITY COMPUTATIONS		RLW	3/16/81

AREAS INPUT INTO STABILITY ANALYSIS PROGRAM

(BASED ON AS-BUILT CROSS-SECTION)

SEGMENT	AREA	DISTANCE TO CENTROID
1	$(2.5)(2) = 5\ ft^2$	1.25 ft
2	$(7.5)(1) = 7.5\ ft^2$	5.75 ft
3	$(11.4)(1) = 11.4\ ft^2$	5.7 ft
4	$6.5(2) = 13\ ft^2$	1 ft
5	$6.5(2) = 13\ ft^2$	10.4 ft

CALCULATE SHEAR RESISTANCE OF THE SHEAR KEYS

1. COMPUTE SHEAR STRENGTH OF CONCRETE

ASSUME 2000 psi CONCRETE

$$\text{SHEAR STRENGTH} = 2\sqrt{f'_c} = 2\sqrt{2000} = 89.44\ psi$$

2. CALCULATE RESISTANCE OF UPSTREAM & DOWNSTREAM KEY SEPERATELY

$$\frac{\text{STRENGTH (AREA/FOOT)}}{1000\ lb/k} = \frac{(89.44\ lb/in^2)(288\ in^2/ft)}{1000\ lb/k} = 25.7\ k/ft \text{ ON EACH KEY}$$

TOTAL SHEAR KEY RESISTANCE $= 2(25.7\ k/ft) = 51.4\ k/ft$

00-15-1 (3/78)
Formerly GA-17

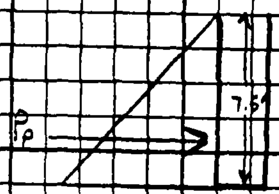
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

PROJECT GRID

JOB	SHEET NO.	CHECKED BY	DATE
MARTIN DUNHAM RESERVOIR DAM	2		
SUBJECT: STRUCTURAL STABILITY COMPUTATIONS		COMPUTED BY: RLW	DATE: 3/17/81

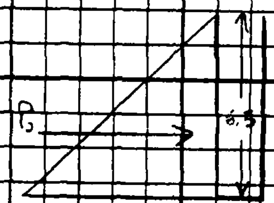
CALCULATE PASSIVE RESISTANCE OF CUTOFF WALLS

DOWNSTREAM WALL



$P_p = \frac{1}{2} K_p \gamma_s H^2 = \frac{1}{2}(3.0)(.055)(7.5)^2 = 4.64 K/ft$

UPSTREAM WALL



$P_p = \frac{1}{2}(3.0)(.055)(6.5)^2 = 3.48 K/ft$

TOTAL PASSIVE RESISTANCE = 8.12 K/ft

∴ TOTAL SHEAR RESISTANCE CAN'T BE DEVELOPED - SOIL WOULD FAIL FIRST

STRUCTURAL STABILITY ANALYSIS

A structural stability analysis was performed for the spillway portion of this structure using a Texas Instrument's TI - 59 Programable Calculator.

The following conditions were analyzed:

1. Normal conditions with water surface at spillway crest.

2. Flood Flow conditions; water surface at crest of dike.

3. Seismic loading; normal conditions with a seismic load of 0.10.

STABILITY ANALYSIS PROGRAM - WORK SHEET

INPUT ENTRY		ANALYSIS CONDITION 1	2	3	4	5
Unit Weight of Dam (K/ft^3)	0	0.15	0.15	0.15		
Area of Segment No. 1 (ft^2)	1	5	5	5		
Distance from Center of Gravity of Segment No. 1 to Downstream Toe (ft)	2	1.25	1.25	1.25		
Area of Segment No. 2 (ft^2)	3	7.5	7.5	7.5		
Distance from Center of Gravity of Segment No. 2 to Downstream Toe (ft)	4	5.75	5.75	5.75		
Area of Segment No. 3 (ft^2)	5	11.4	11.4	11.4		
Distance from Center of Gravity of Segment No. 3 to Downstream Toe (ft)	6	5.7	5.7	5.7		
Base Width of Dam (Total) (ft) * * REDUCED TO ACCOUNT FOR CUTOFF	7	4	4	4		
Height of Dam (ft)	8	12	12	12		
Ice Loading (K/L ft.)	9					
Coefficient of Sliding	10	0.50	.50	.50		
Unit Weight of Soil (K/ft^3) (deduct 18)	11	0.055	.055	.055		
Active Soil Coefficient - Ka	12	0.33	0.33	0.33		
Passive Soil Coefficient - Kp	13	3.0	3.0	3.0		
Height of Water over Top of Dam or Spillway (ft)	14		6.0			
Height of Soil for Active Pressure (ft)	15	8	8	8		
Height of Soil for Passive Pressure (ft)	16	7.5	7.5	7.5		
Height of Water in Tailrace Channel (ft)	17	8	10			
Weight of Water (K/ft^3)	18	0.0624	.0624	.0624		
Area of Segment No. 4 (ft^2)	19	13	13	13		
Distance from Center of Gravity of Segment No. 4 to Downstream Toe (ft)	20	1	1	1		
Height of Ice Load or Active Water (ft) (does not include 14)	46	12	12	12		
Seismic Coefficient (g)	50			0.10		
	21	13	13			
RESULTS OF ANALYSIS	22	10.4	10.4			
Factor of Safety vs. Overturning		2.26	1.18	2.06		
Distance From Toe to Resultant		6.31	1.95	5.81		
Factor of Safety vs. Sliding		1.80	1.06	1.44		

APPENDIX E

REFERENCES

AD-A105 839 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/13
NATIONAL DAM SAFETY PROGRAM. MARTIN DUNHAM RESERVOIR DAM (INVEN--ETC(U)
MAY 81 G KOCH DACW51-79-C-0001
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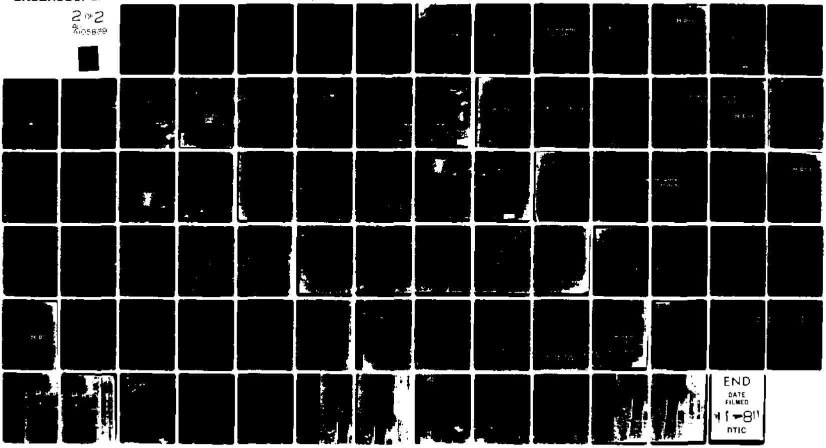

APPENDIX E

REFERENCES

APPENDIX

REFERENCES

1) M.G. Cline and R.L. Marshall, Soils of New York Landscapes - Information Bulletin 119, New York State College of Agriculture and Life Sciences, Cornell University, August 1977.

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7) Generalized Soils Report - Capital District Region, CDRPC - TR - 200 - 1, August 1974.

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9) Hydrometerorological Report No. 33: Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6,12,24, and 48 Hours, April 1956.

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11) Water Supply Paper 1302 (Through September 1950), 1960

12) Water Supply Paper 1722 (October 1950 to September 1960), 1964

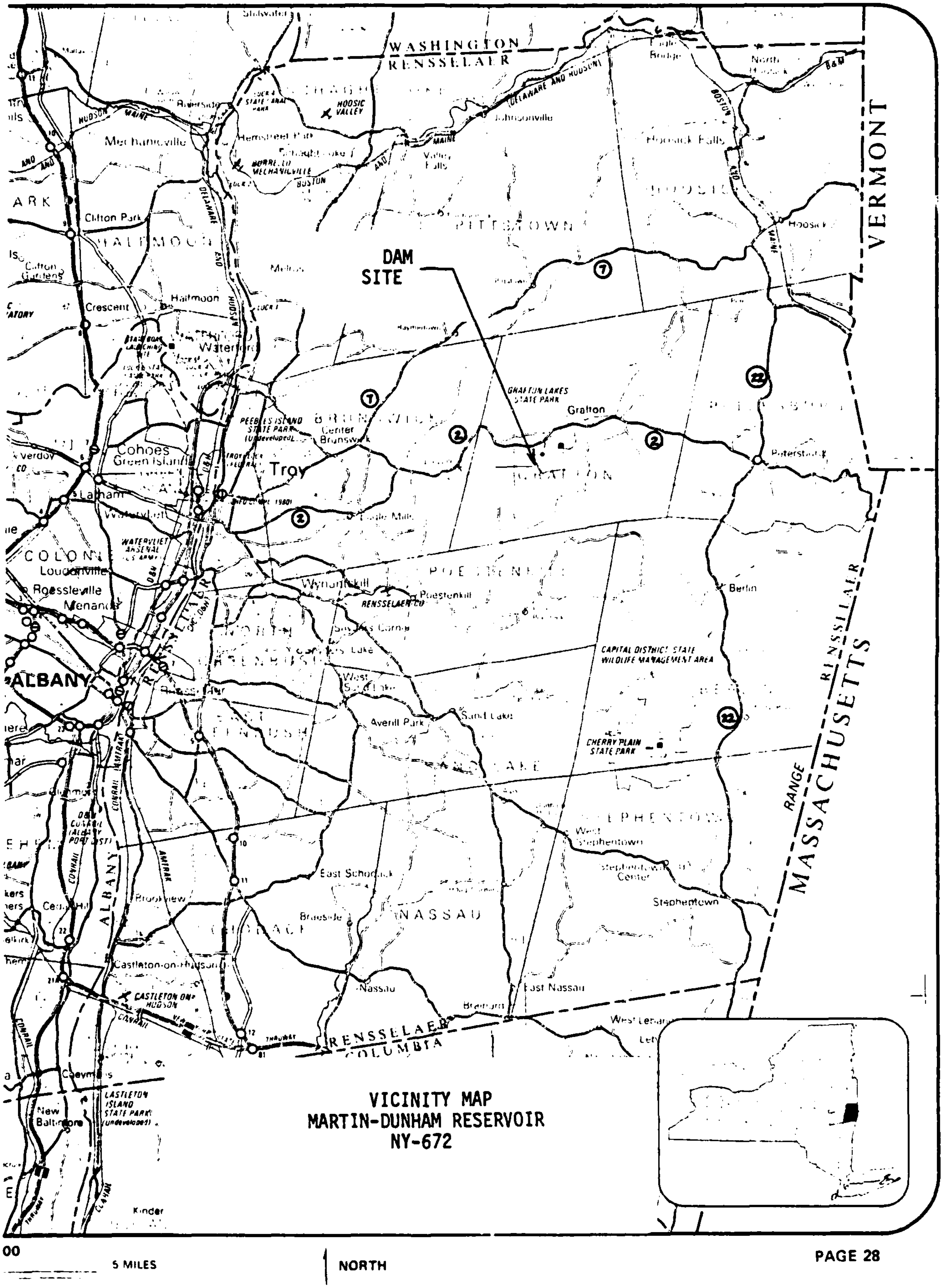
U.S. Geological Survey:

13) Water Resources Data for New York - 1968.

APPENDIX F

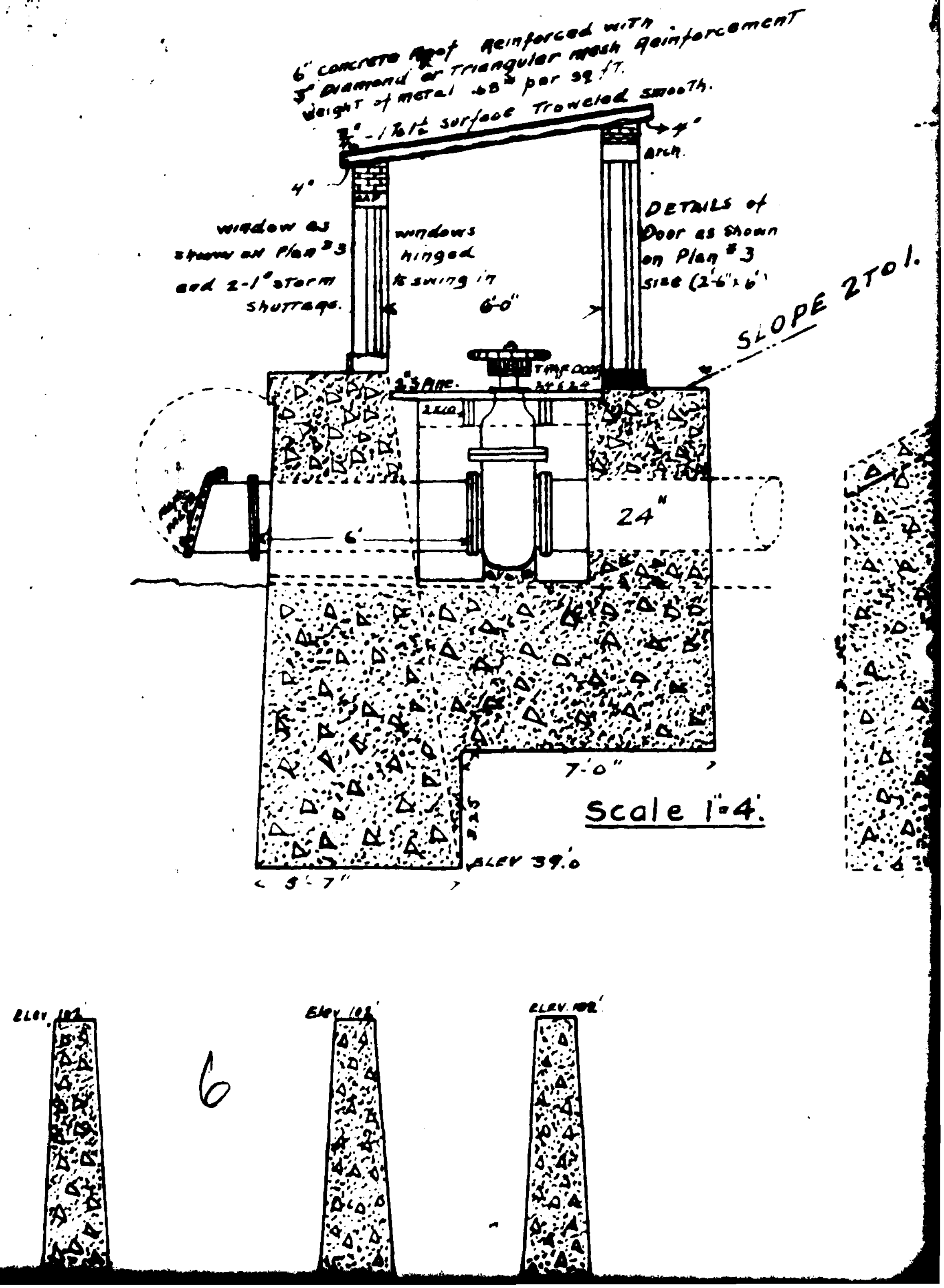
DRAWINGS

ALBANY, RENSSELAER and SCHENECTADY COUNTIES



VICINITY MAP
MARTIN-DUNHAM RESERVOIR
NY-672

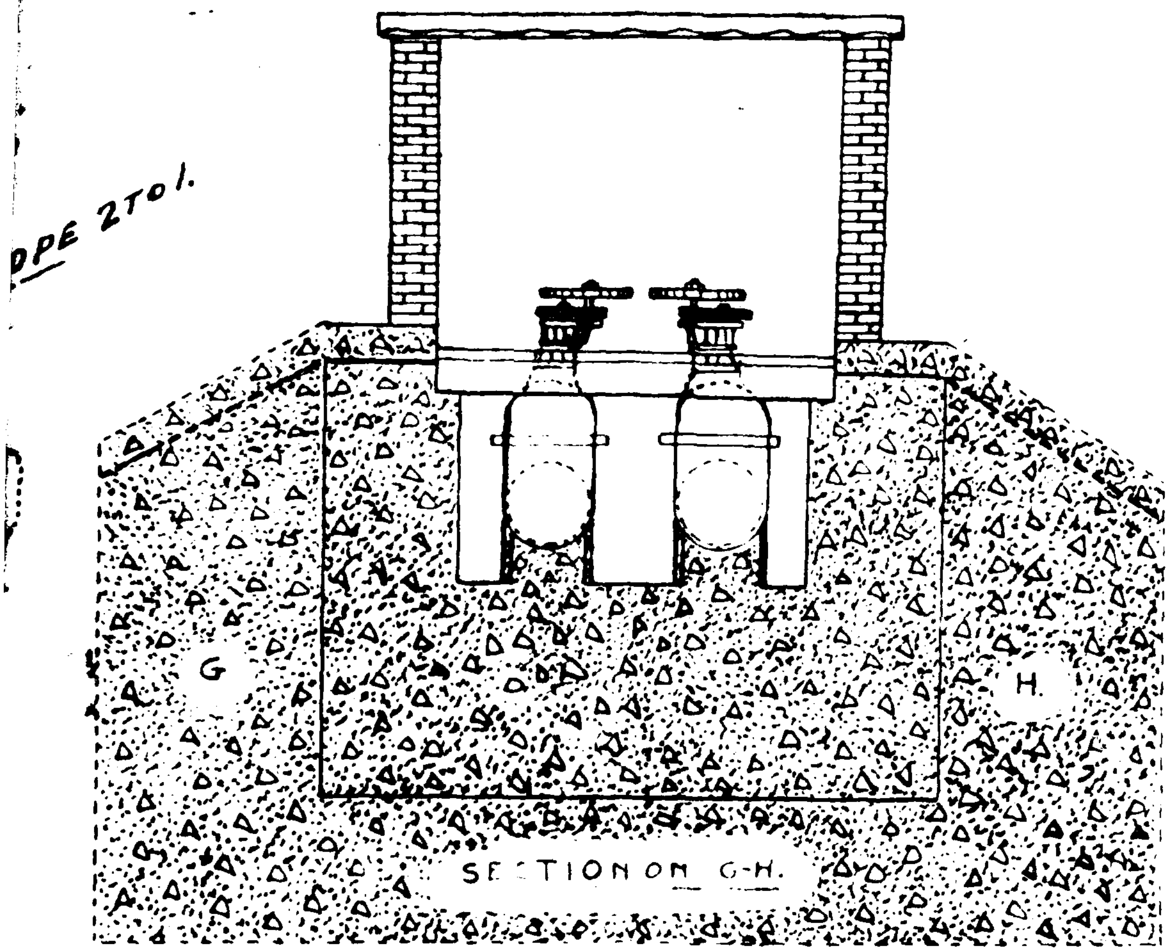
1



6" concrete Roof Reinforced with
3" Diamond or Trianguler mesh Reinforcement
weight of metal .65# per sq ft.
surface Troweled smooth.
4"
arch.
4"
window as
shown on Plan #3
and 2-1" storm
shuttage.
windows
hinged
to swing in
6'-0"
DETAILS of
Door as shown
on Plan #3
size (2'-6"x6')
SLOPE 2 TO 1.
TRAP DOOR
24"
6'
7'-0"
Scale 1"=4'.
ELEV 39.0
5'-7"
ELEV. 102
Elev 102'
ELEV. 102'

6

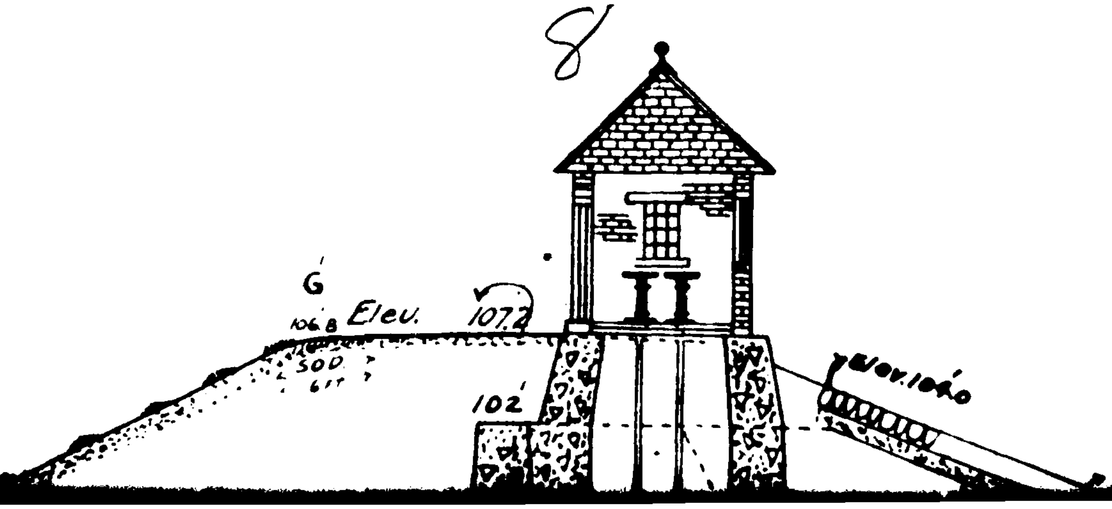
2

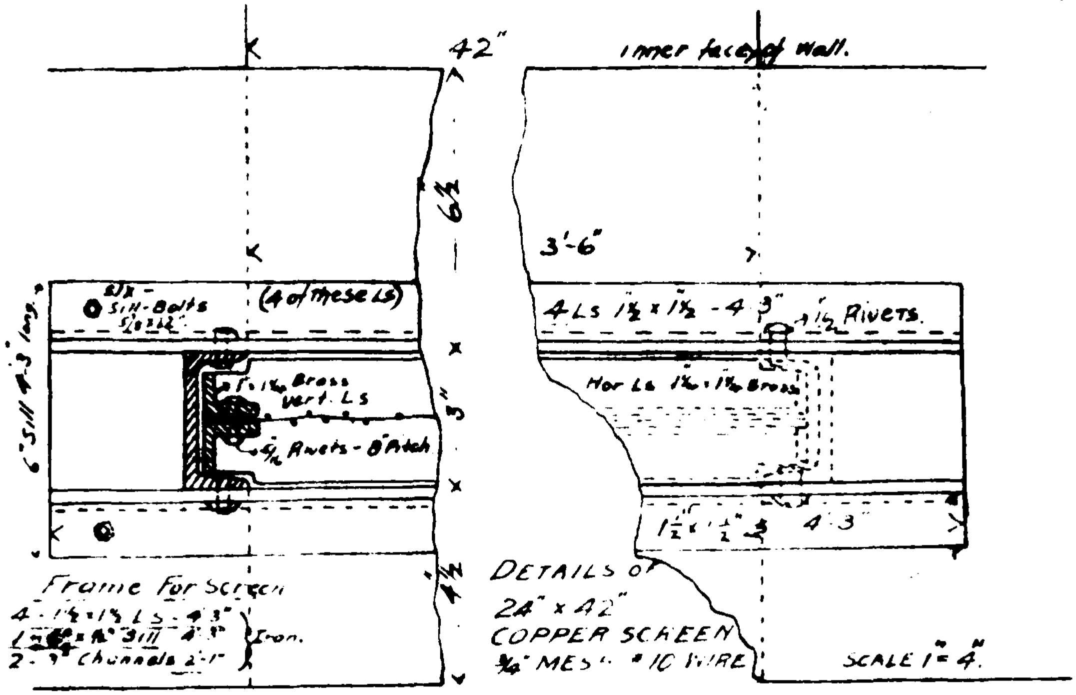


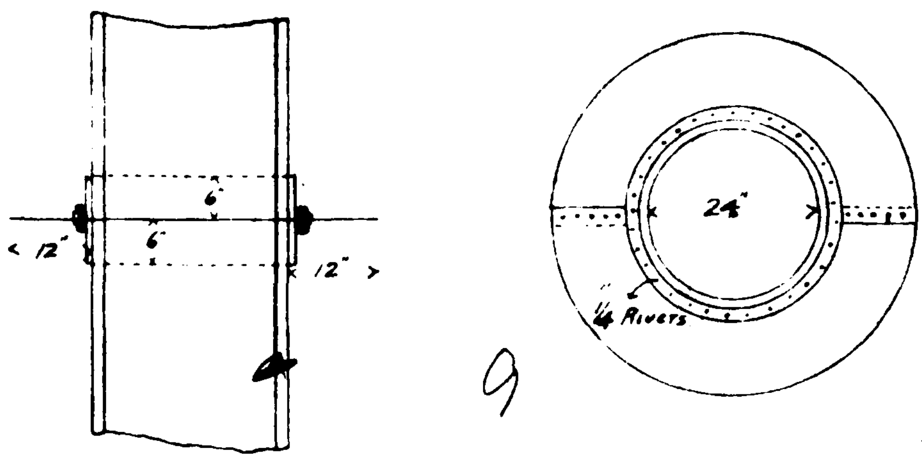
7

TROY WATER WORKS EXTENSION.

SECTION THRU-PIPE LINE.



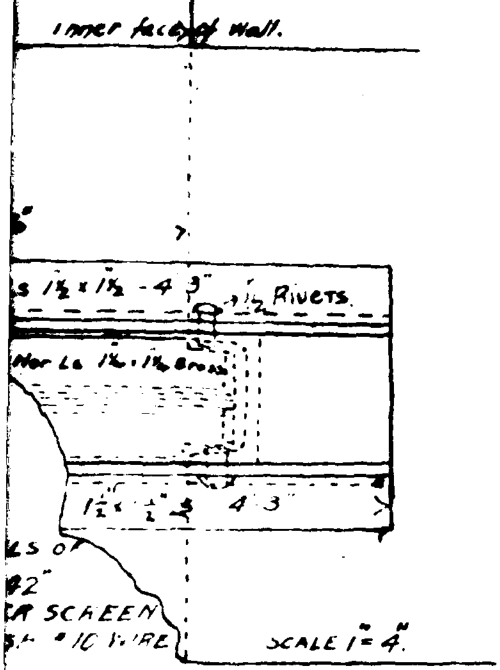




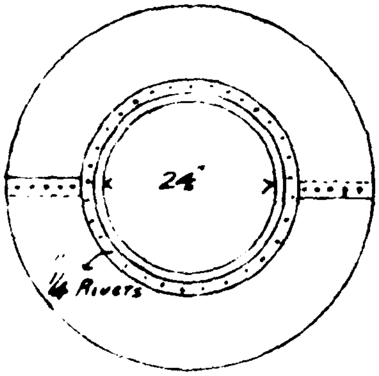
9

DETAIL OF COLLAR
Nº 6 .203 IN
FOR CUT OFF WALL
4 COLLARS REQUIRED

Elev 74'
14"
Walls Reinforced
Spaced

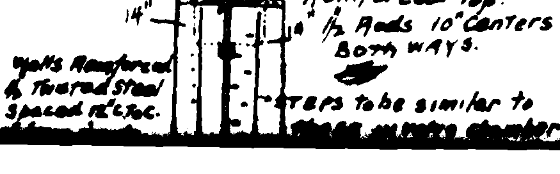


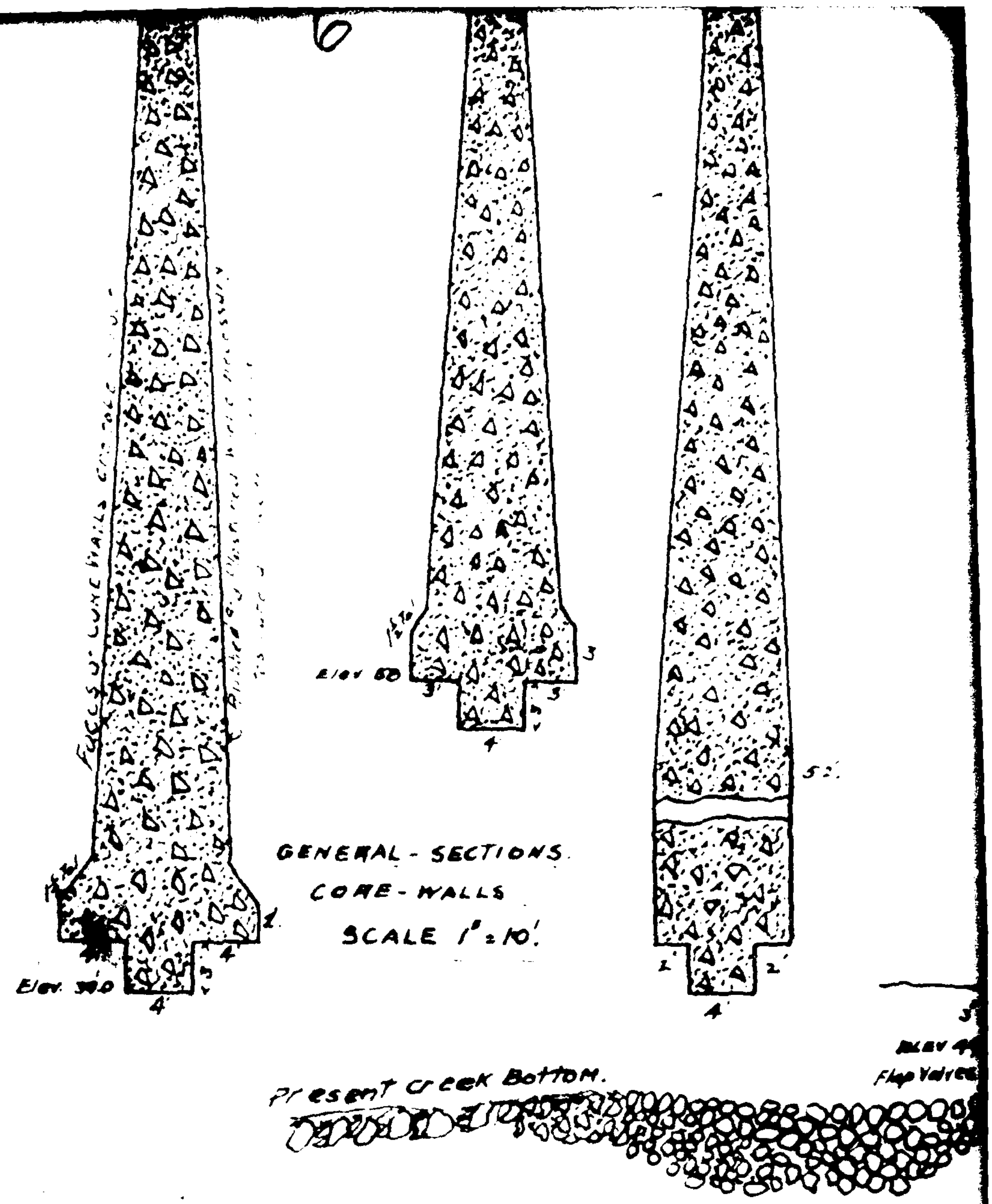
M.-D.IV.



10

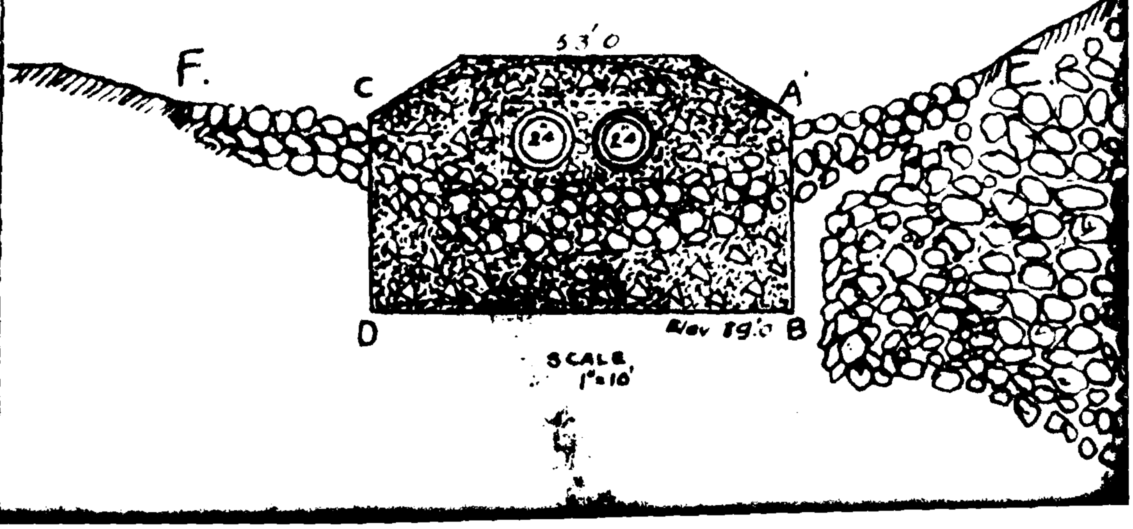
OF COLLAR
.203 IN
OFF WALL
REQUIRED



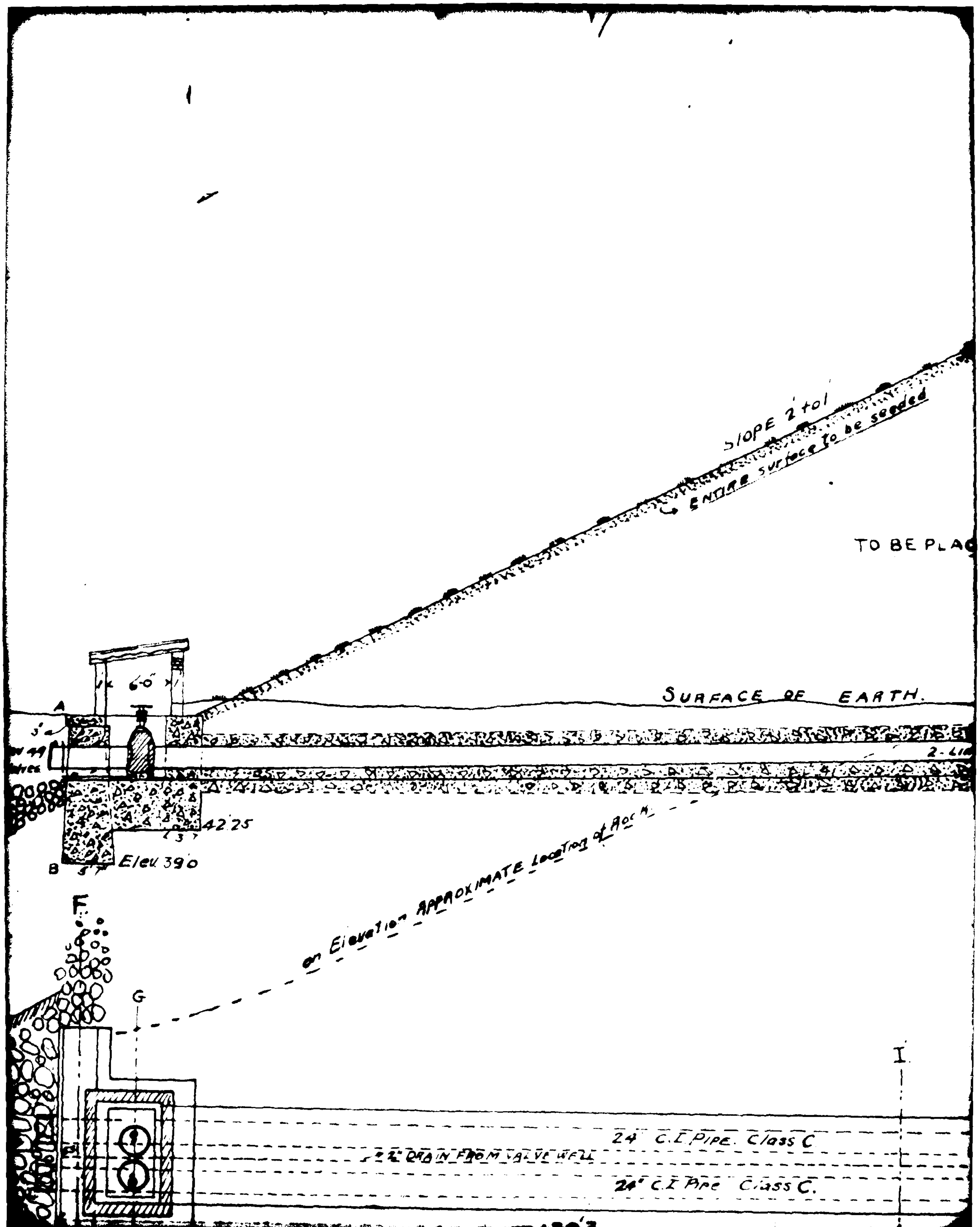


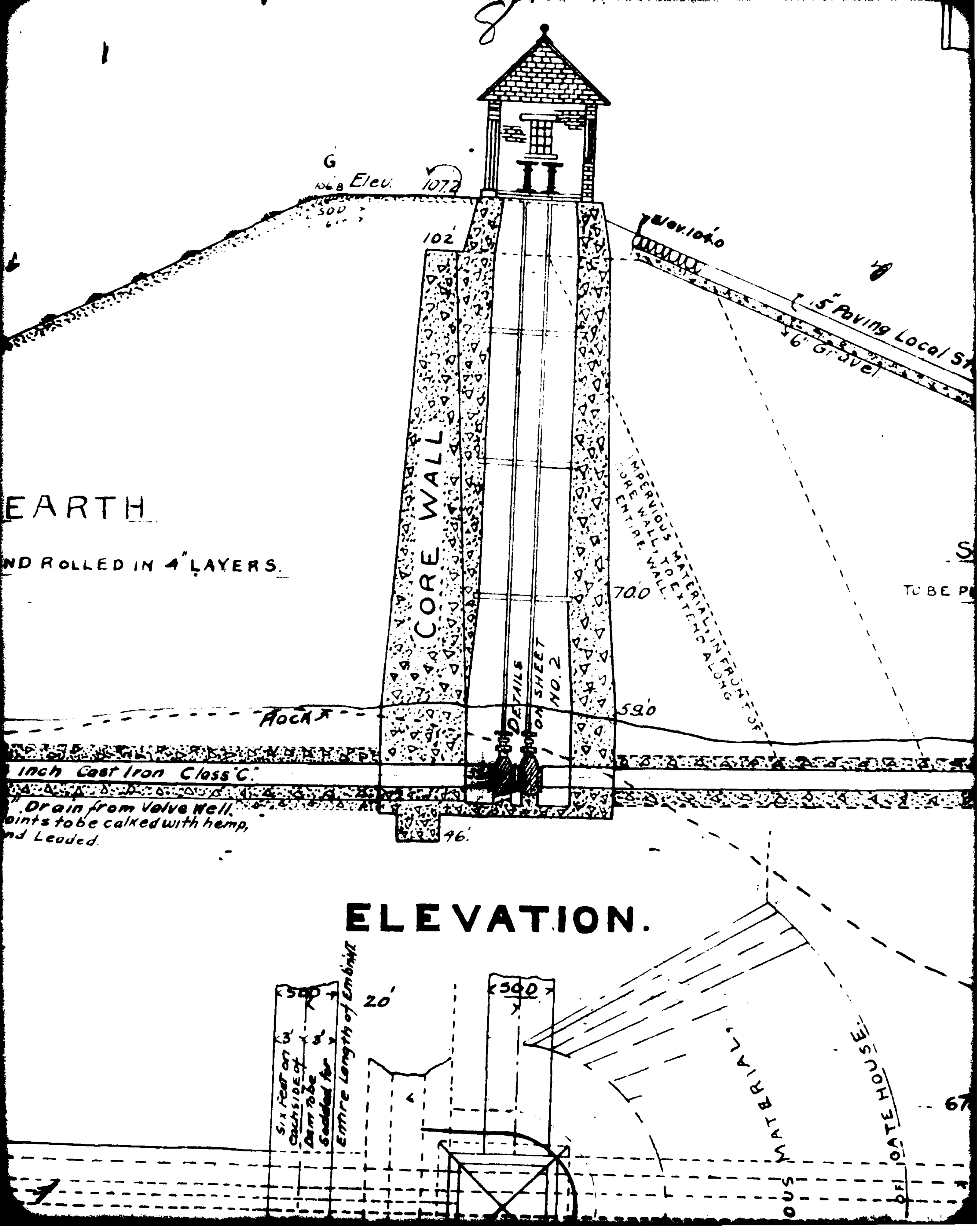
GENERAL - SECTIONS
CORE - WALLS
SCALE 1" = 10'

SECTION ON E-F

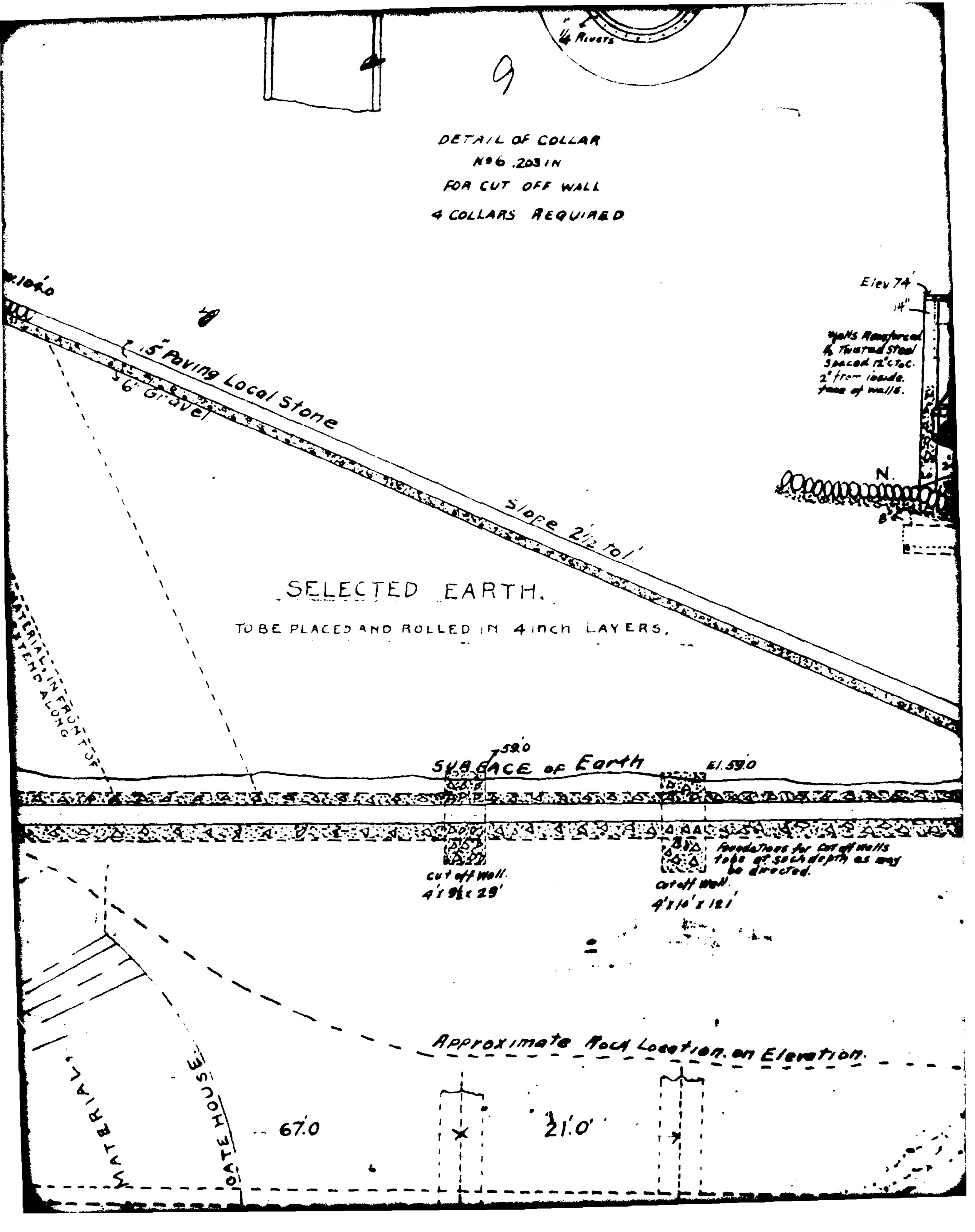


SCALE
1" = 10'

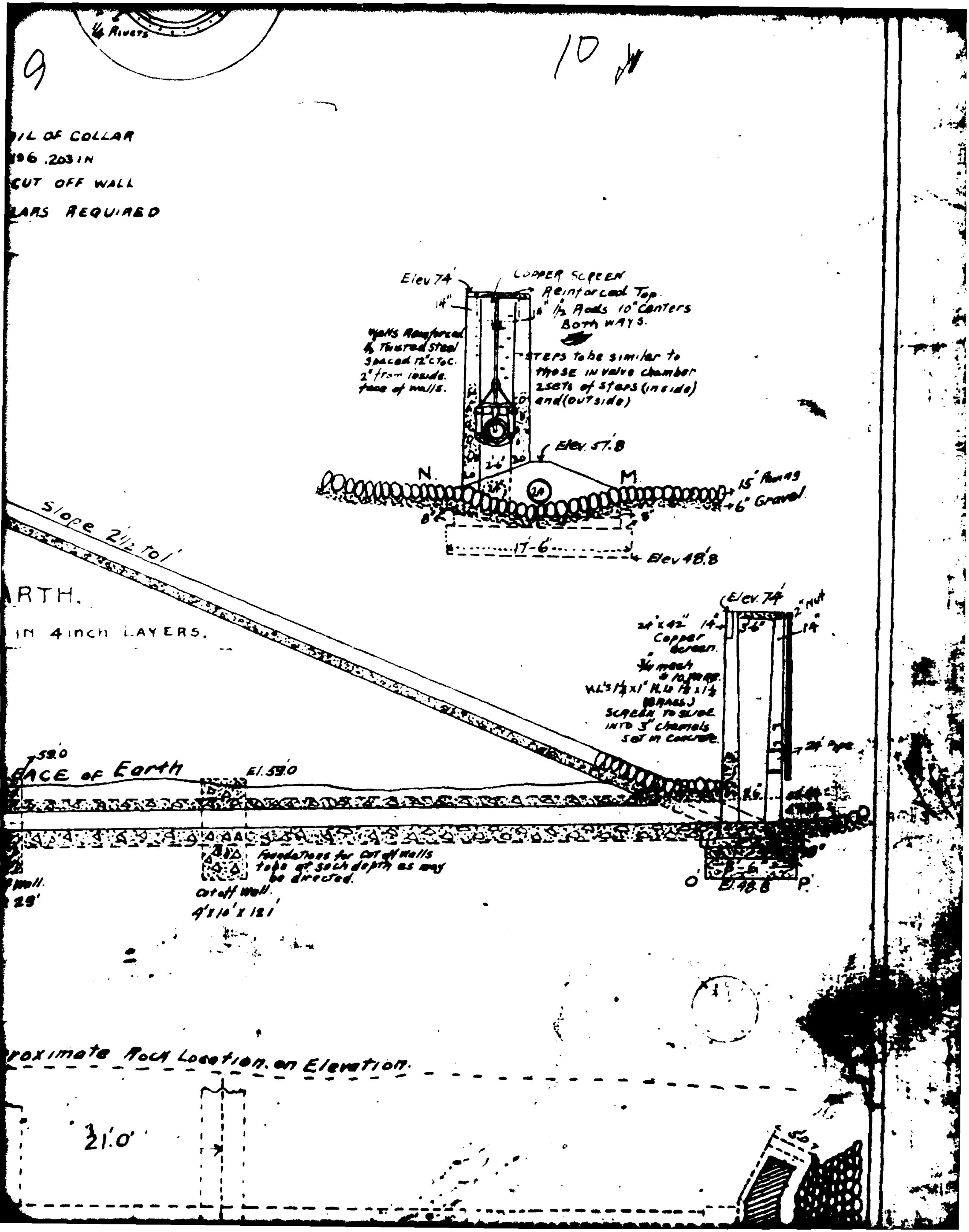

SLOPE 2 to 1
ENTIRE surface to be seeded
TO BE PLA
SURFACE OF EARTH.
A
6'-0"
2-LI
42.25
Elev. 39.0
B
F
G
I
on Elevation APPROXIMATE Location of Rock
24" C.I. Pipe Class C
DRAIN FROM VALVE WELL
24" C.I. Pipe Class C.



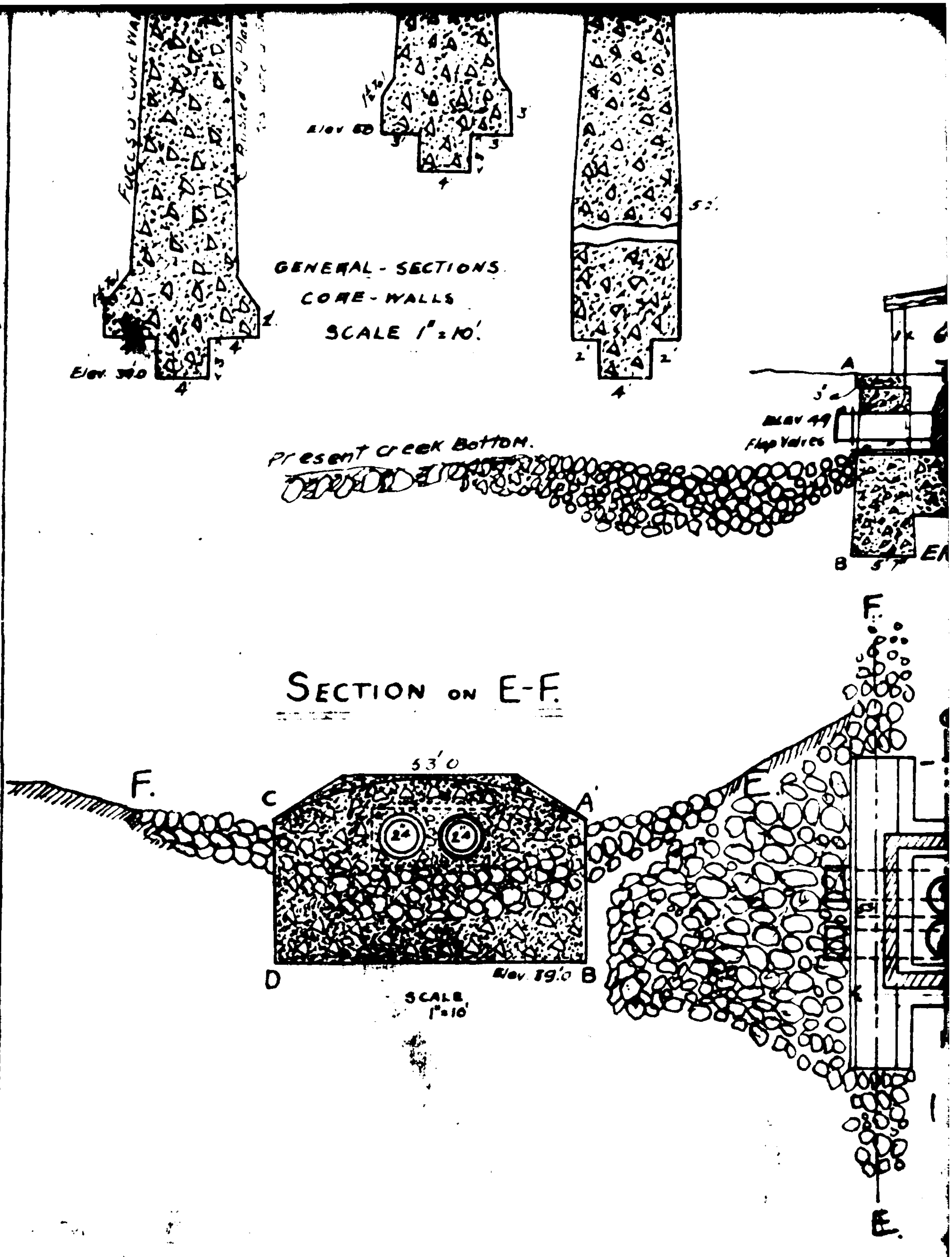
8
G
106.8 Elev. 107.2
SOD
102'
Elev. 104.0
1.5" Paving Local St
6" Gravel
EARTH
ND ROLLED IN 4" LAYERS.
CORE WALL
IMPERVIOUS MATERIAL IN FRONT OF CORE WALL, TO EXTEND ALONG ENTIRE WALL
70.0
DETAILS ON SHEET NO. 2
ROCK
59.0
inch Cast Iron Class "C."
" Drain from Valve Well.
oints to be calked with hemp,
nd Leaded.
46'
TO BE P
ELEVATION.
SOD
20'
3'
Six feet on each side of Dam to be Sodded for Entire Length of Embankt.
OUS MATERIAL
OF GATE HOUSE
67

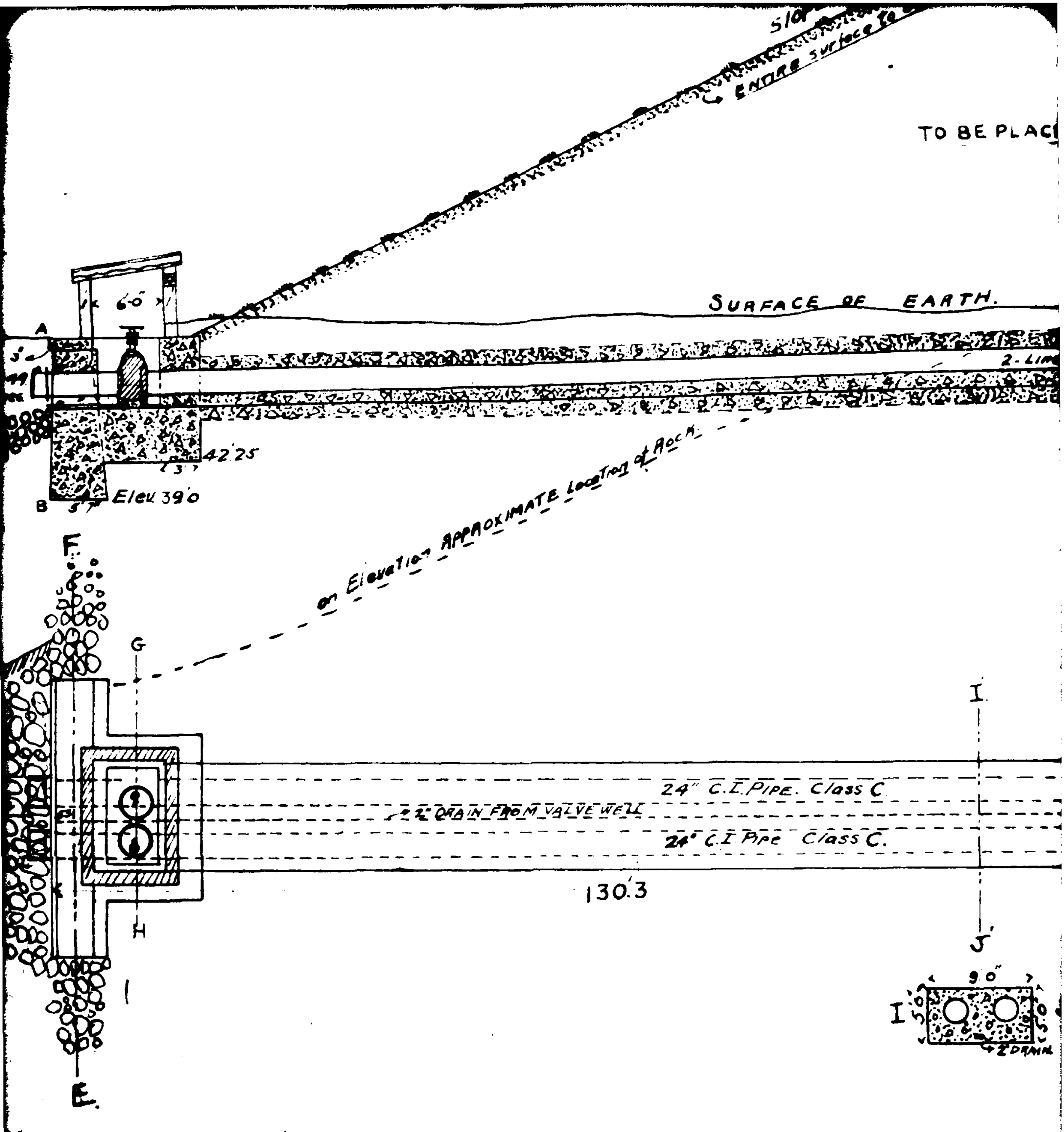


1/4 Rivets
9
DETAIL OF COLLAR
No 6 .203 IN
FOR CUT OFF WALL
4 COLLARS REQUIRED
Elev 74'
14"
Walls Reinforced
Twisted Steel
Spaced 12" C To C.
2" from inside
face of walls.
N.
15" Paving Local Stone
6" Gravel
Slope 2 1/2 to 1'
SELECTED EARTH.
TO BE PLACED AND ROLLED IN 4 inch LAYERS.
59.0
SURFACE of Earth
El. 59.0
Foundations for cut off walls
to be at such depth as may
be directed.
cut off wall.
4' 9 1/2 x 29'
cut off wall.
4' x 10' x 12'
Approximate Rock Location on Elevation.
67.0
21.0'
GATE HOUSE
MATERIAL

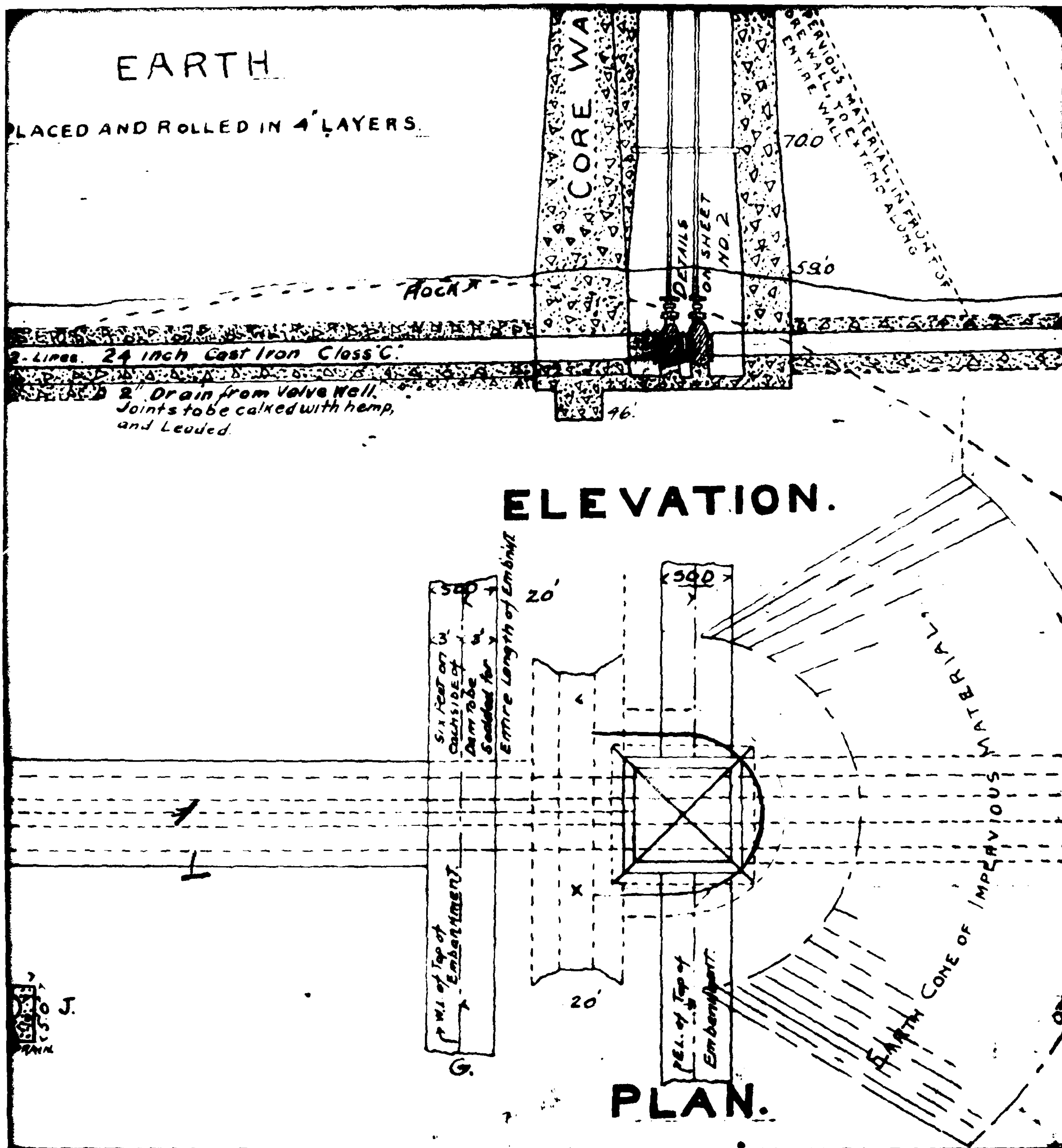


¼ Rivets
9
10
IL OF COLLAR
96 .203 IN
CUT OFF WALL
LARS REQUIRED
Elev 74'
COPPER SCREEN
Reinforced Top
14"
4" ½ Rods 10" Centers
Both WAYS.
Walls Reinforced
½ Twisted Steel
Spaced 12" C to C.
2" from inside
face of walls.
STEPS to be similar to
those in valve chamber
2 sets of steps (inside)
and (outside)
Elev. 57.8
N.
M.
15" Paving
6" Gravel
17'-6"
Elev 48.8
Slope 2½ to 1'
RTH.
IN 4 inch LAYERS.
Elev 74'
2" Nut
24"x42"
14"
3'-6"
14"
Copper Screen
¾ mesh
#10 wire
Screen to slide
into 3" channels
set in concrete.
24" Pipe
59.0
ACE of Earth
El. 59.0
Foundations for cut off walls
to be at such depth as may
be directed.
Cut off Wall
4' x 10' x 12'
O.
P.
El. 48.8
roximate Rock Location on Elevation
21.0'

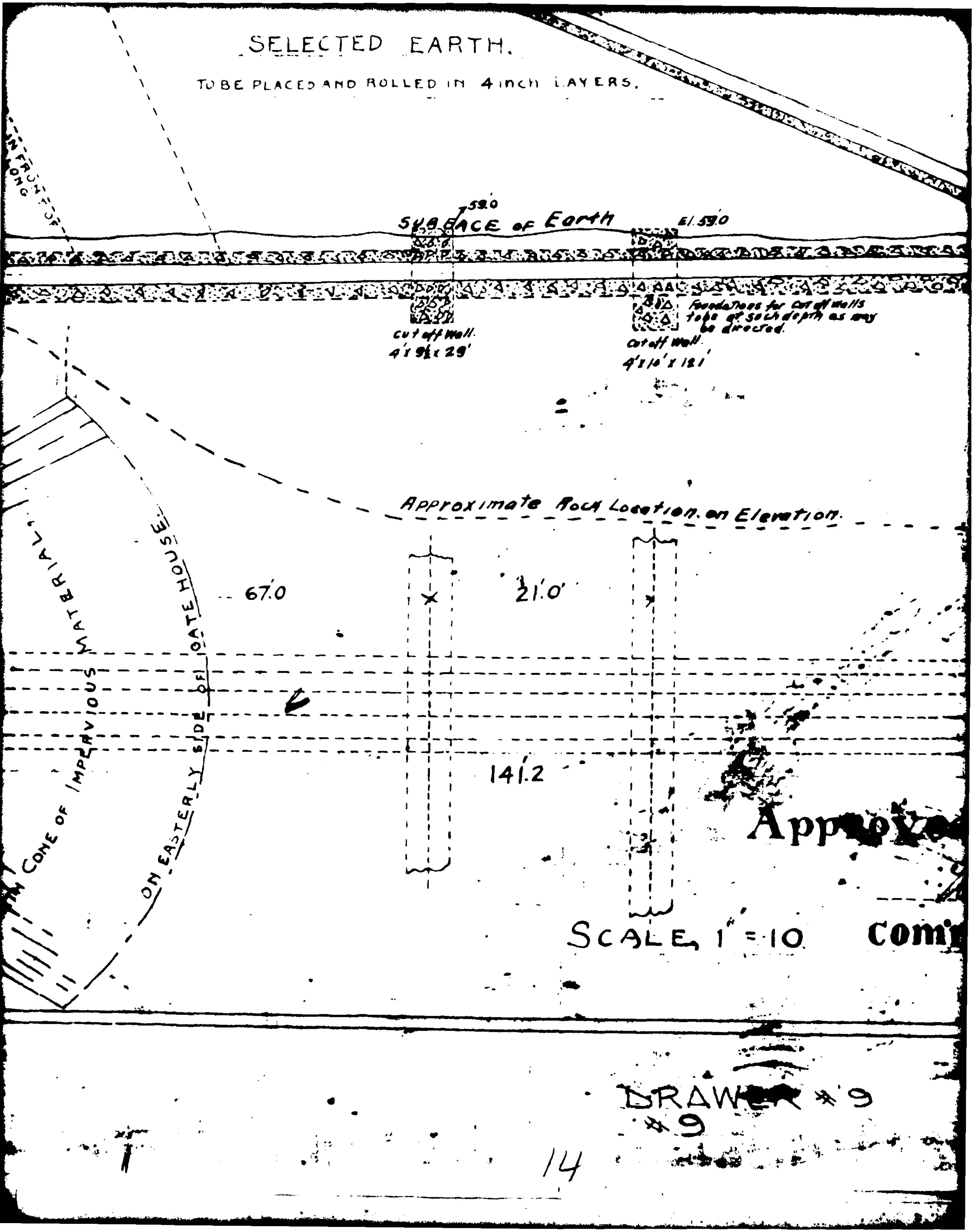

GENERAL - SECTIONS
CORE - WALLS
SCALE 1" = 10'
Elev. 39.0
Elev 50
Elev 49
Flap Valves
Present creek bottom.
SECTION ON E-F.
53'0
F.
C
A
D
B
E.
Elev 39.0
SCALE 1" = 10'



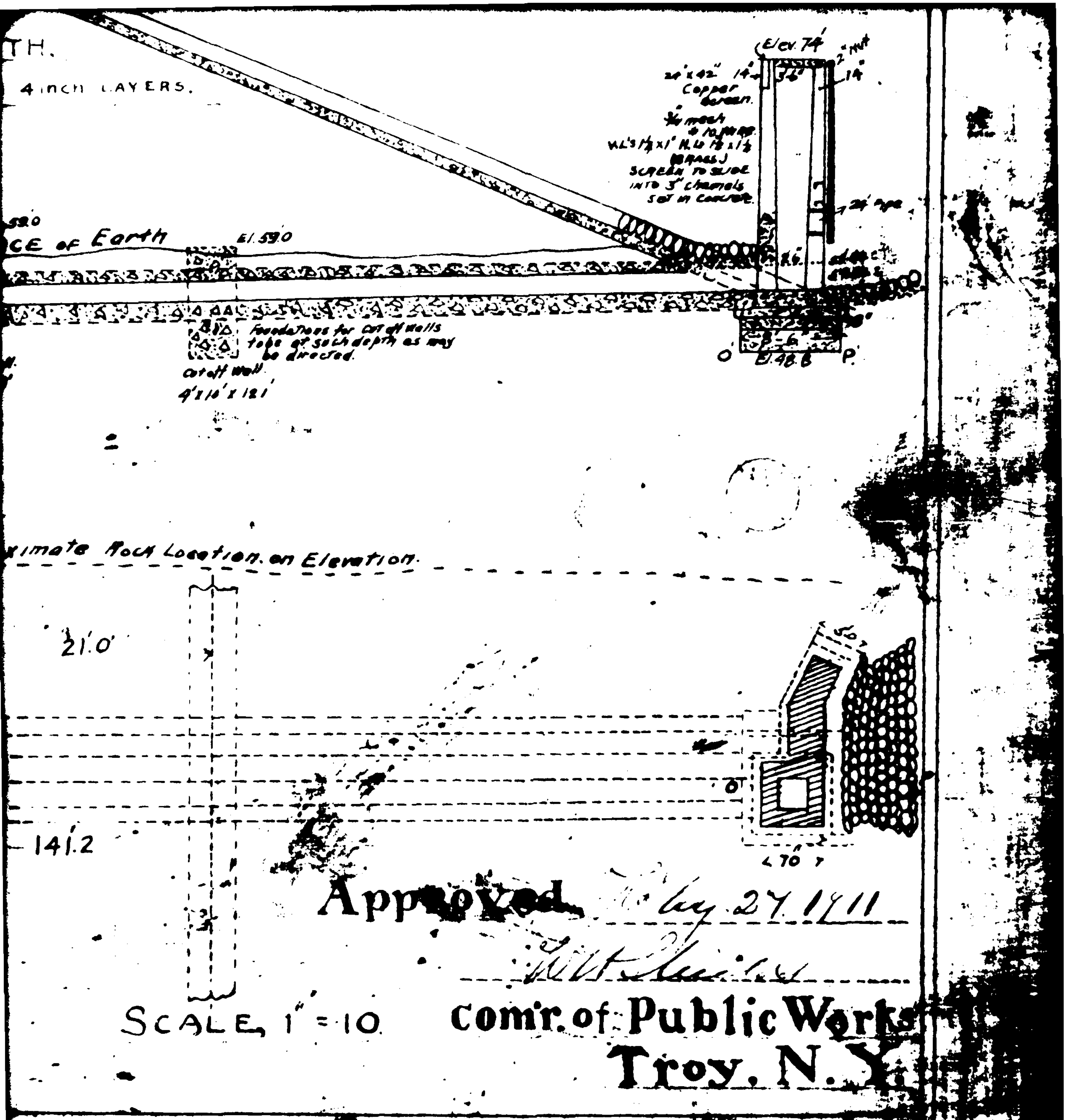
ENTIRE surface to
TO BE PLAC
SURFACE OF EARTH.
6'0"
A
3'
2-Lin
42.25
3'
B
5'
Elev. 39.0
on Elevation APPROXIMATE Location of Rock.
F
G
I
24" C.I. Pipe. Class C
2" DRAIN FROM VALVE WELL
24" C.I. Pipe Class C.
130.3
H
J
E
9'0"
I
5'0"
2" DRAIN



EARTH
PLACED AND ROLLED IN 4" LAYERS
CORE WA
700
590
DETAILS ON SHEET NO. 2
ROCK
2 LINES 24 inch Cast Iron Class "C."
2" Drain from Valve Well. Joints to be calked with hemp, and Leaded.
46
ELEVATION.
500
20'
3' 3'
Six feet on each side of Dam to be Sodded for Entire Length of Embkmt.
W.L. of Top of Embankment
EL. of Top of Embankment
G.
J.
EARTH CONE OF IMPERVIOUS MATERIAL
PLAN.

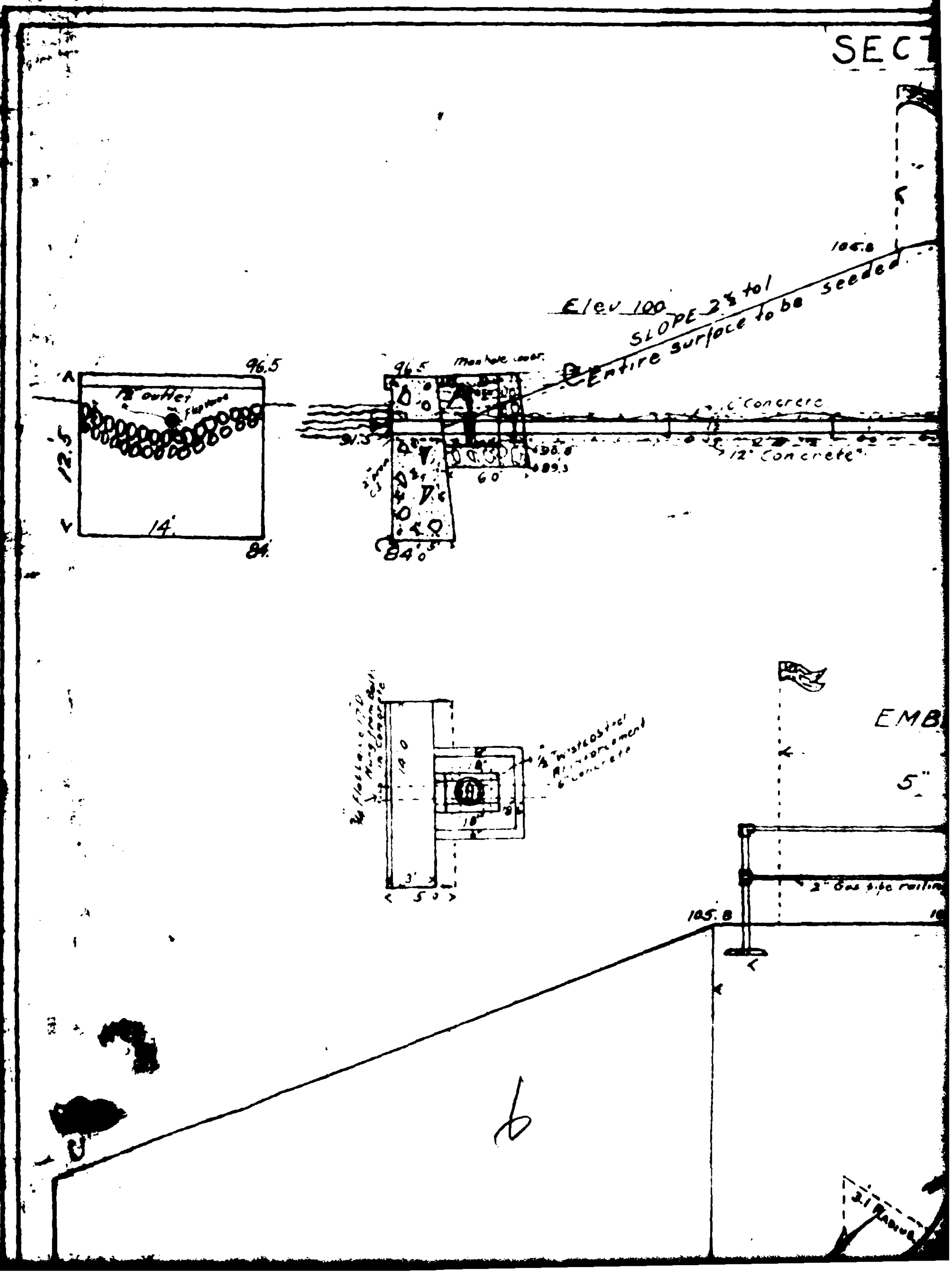


SELECTED EARTH.
TO BE PLACED AND ROLLED IN 4 inch LAYERS.
IN FRONT OF
SURFACE of Earth
59.0
El. 59.0
Foundations for cut off walls to be at such depth as may be directed.
cut off Wall. 4'x 9½ x 29'
cut off Wall. 4'x 10' x 12'
Approximate Rock Location on Elevation.
67.0
21.0'
141.2
CONE OF IMPERVIOUS MATERIAL
ON EASTERLY SIDE OF GATE HOUSE.
SCALE, 1" = 10
DRAWER #9
#9
14

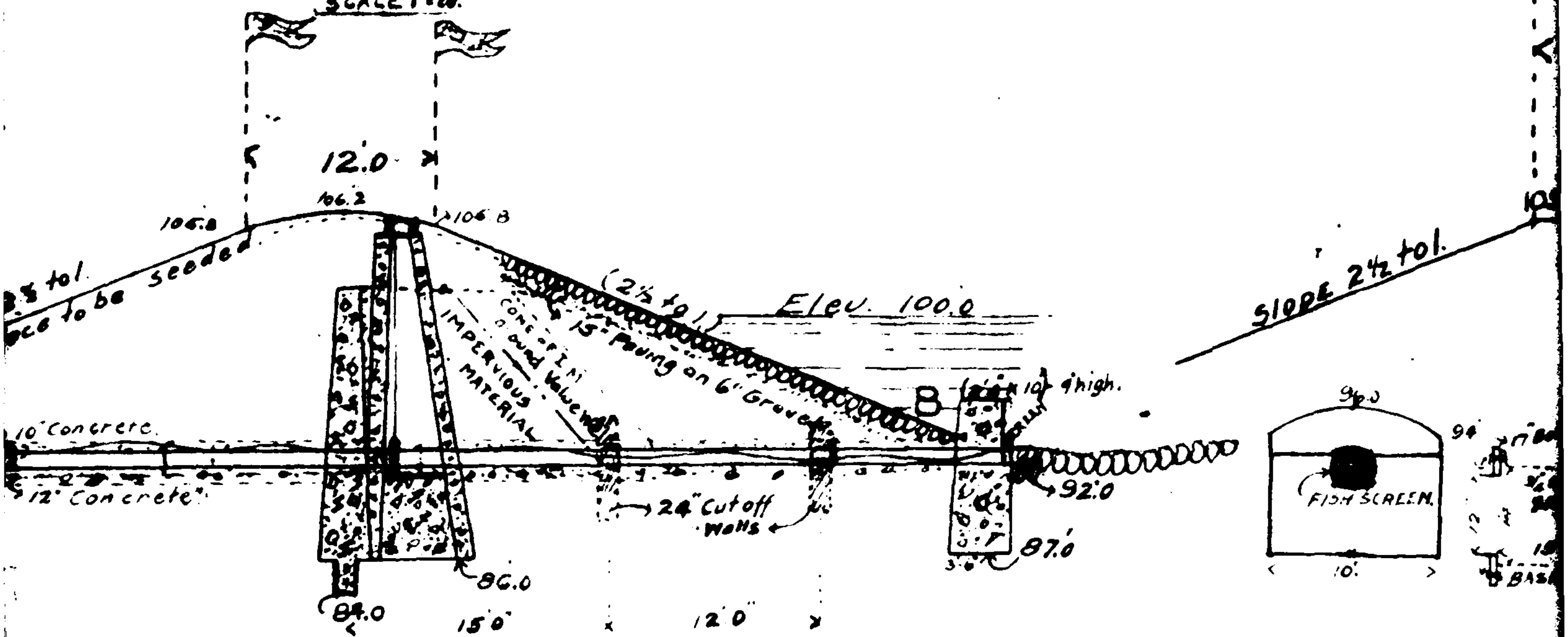

TH.
4 inch LAYERS.
Elev. 74'
Copper Screen
CE of Earth
El. 59.0
Foundations for cut off walls to be of such depth as may be directed
cut off wall
O
P
El. 48.6
ximate Rock Location on Elevation
21.0'
141.2
SCALE, 1" = 10
Approved May 27 1911
Com'r. of Public Works
Troy, N.Y.

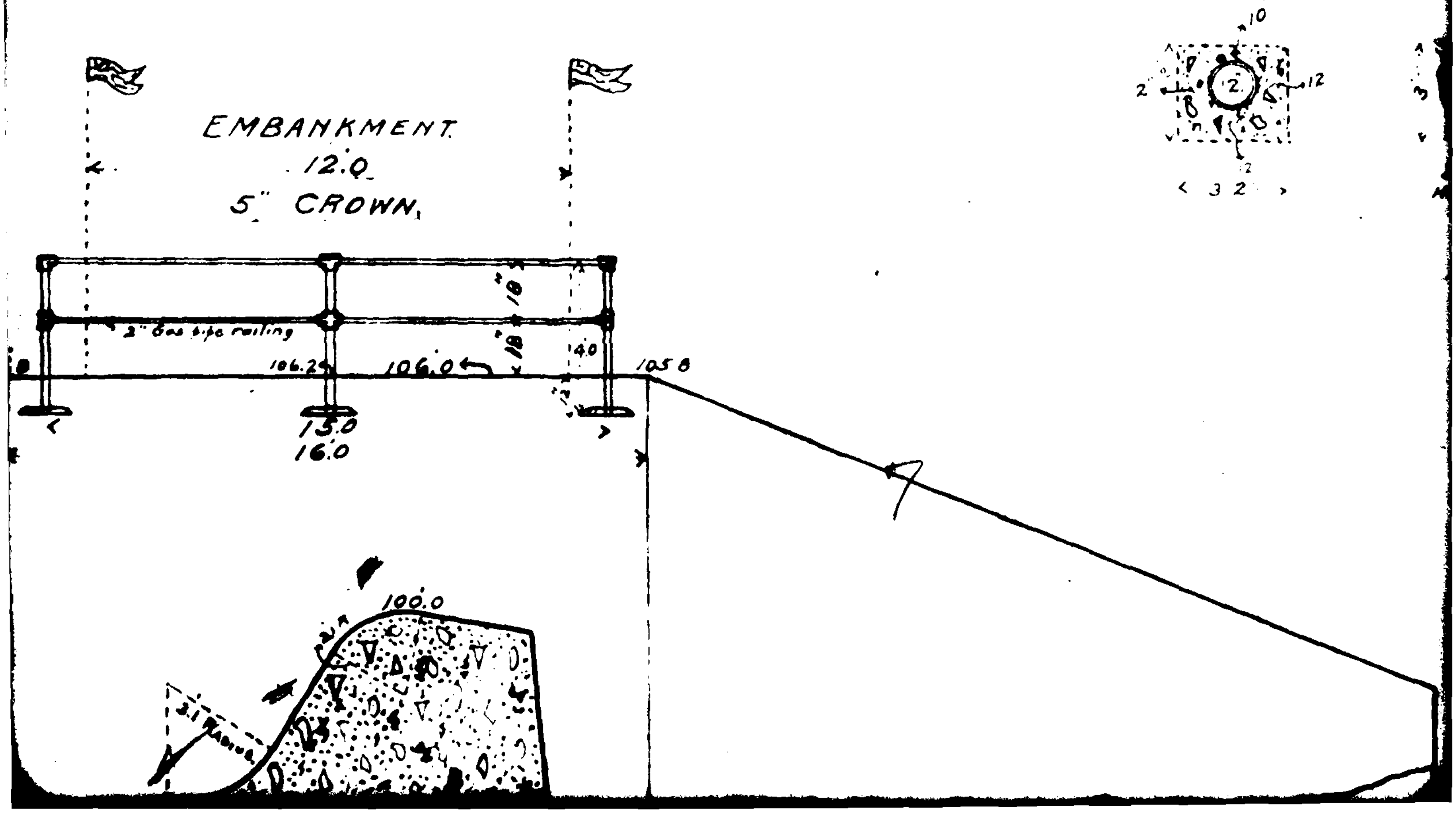
DRAWER #9
#9

14


SECT
105.8
Elev 100
SLOPE 2 to 1
Entire surface to be seeded
96.5
A
12" outlet
Flap valve
12.5
14'
84'
96.5
Manhole cover
6" Concrete
12" Concrete
60'
89.3
84'0"
EMB
5"
2" Gas pipe railing
105.8
6

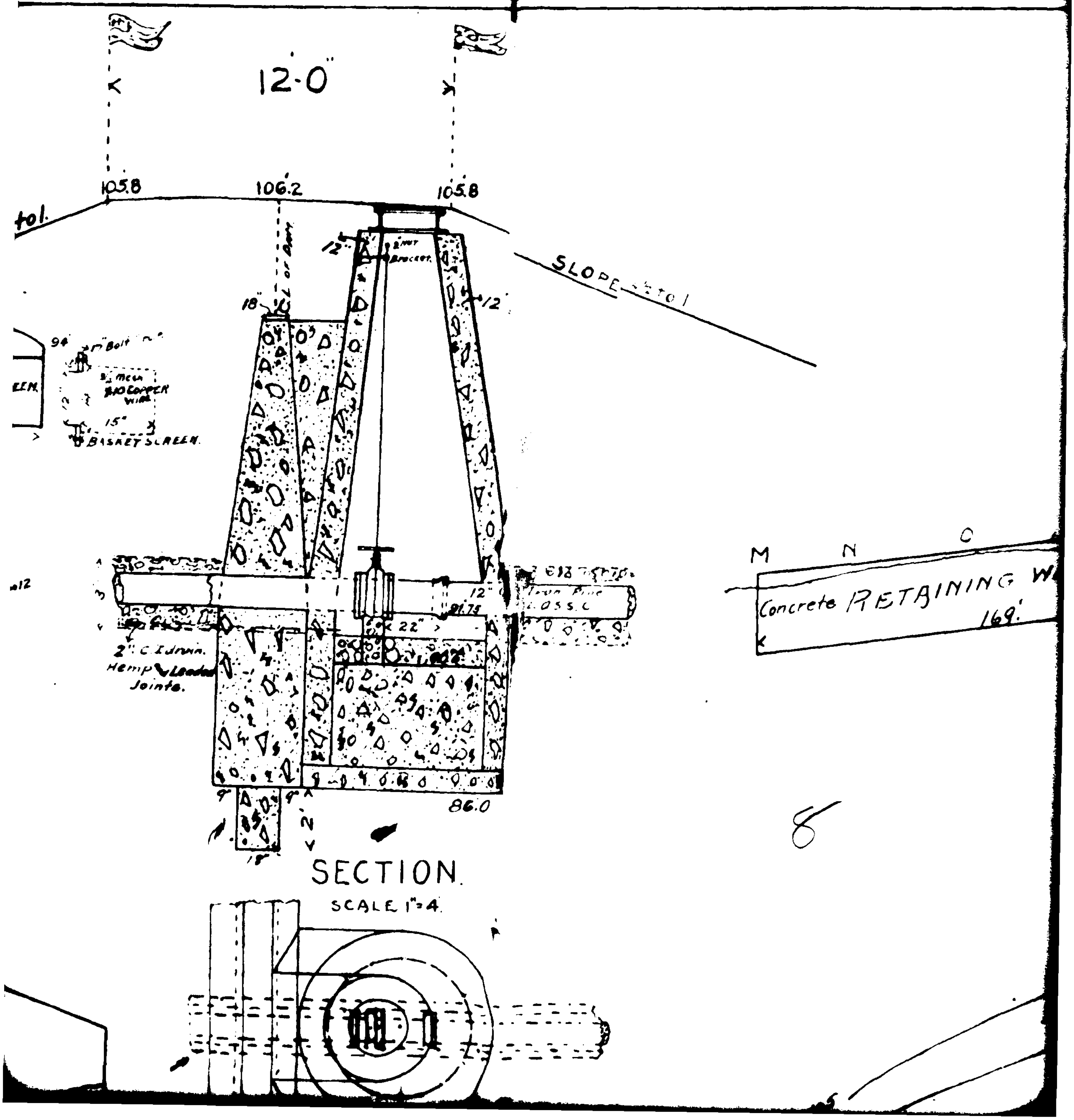
SECTION ON A-B.





1

3

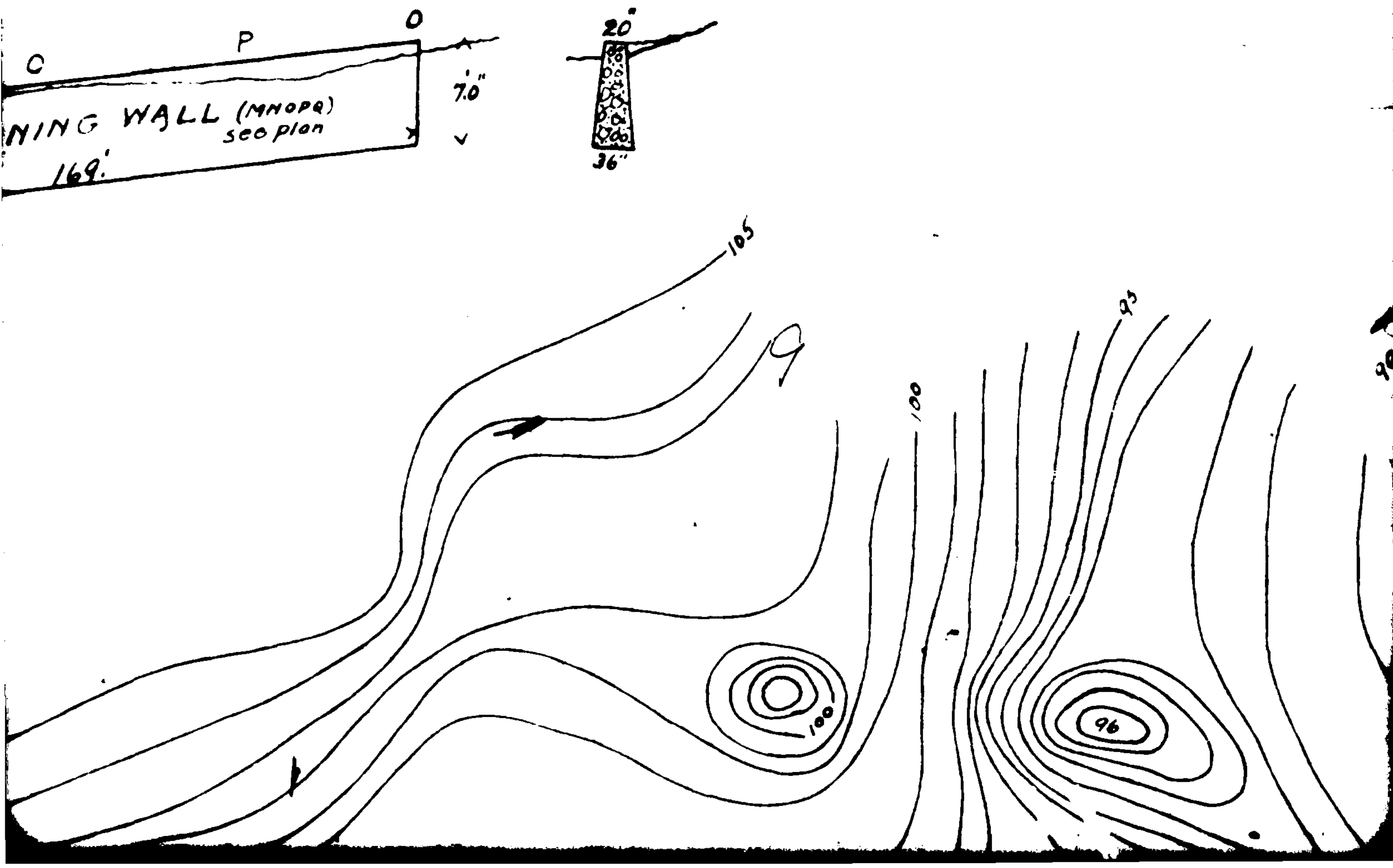


12·0"
105.8
106.2
105.8
to 1.
SLOPE
12"
18"
12"
BASKET SCREEN
15"
2" C.I. drain.
Hemp & Leaded
Joints.
Iron Pipe
12"
91.75
22"
9"
9"
18"
86.0
M
N
O
Concrete RETAINING W
169'
SECTION
SCALE 1"=4'

8

4

TROY WATER
EXTENSIO
DETAILS OF S



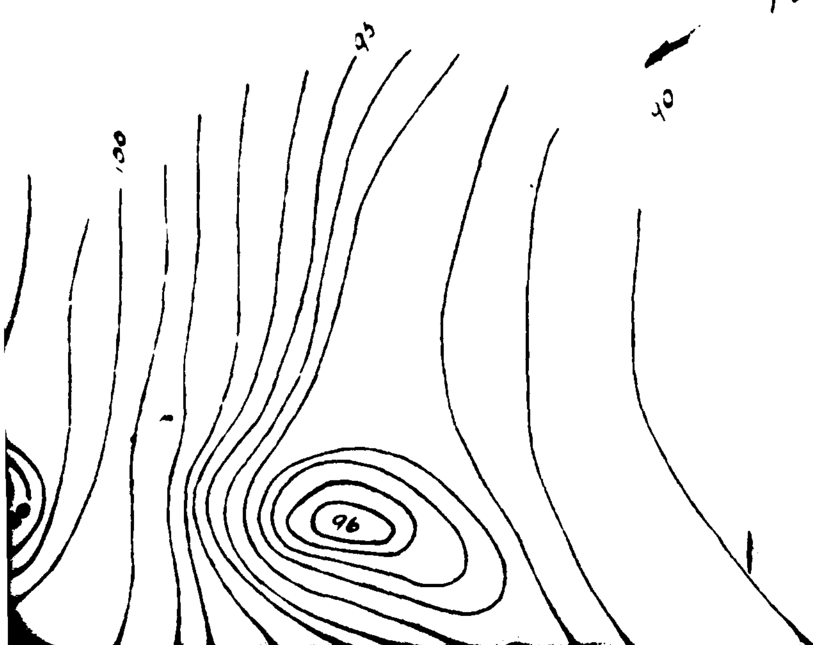
5

TROY WATER WORKS
EXTENSION.

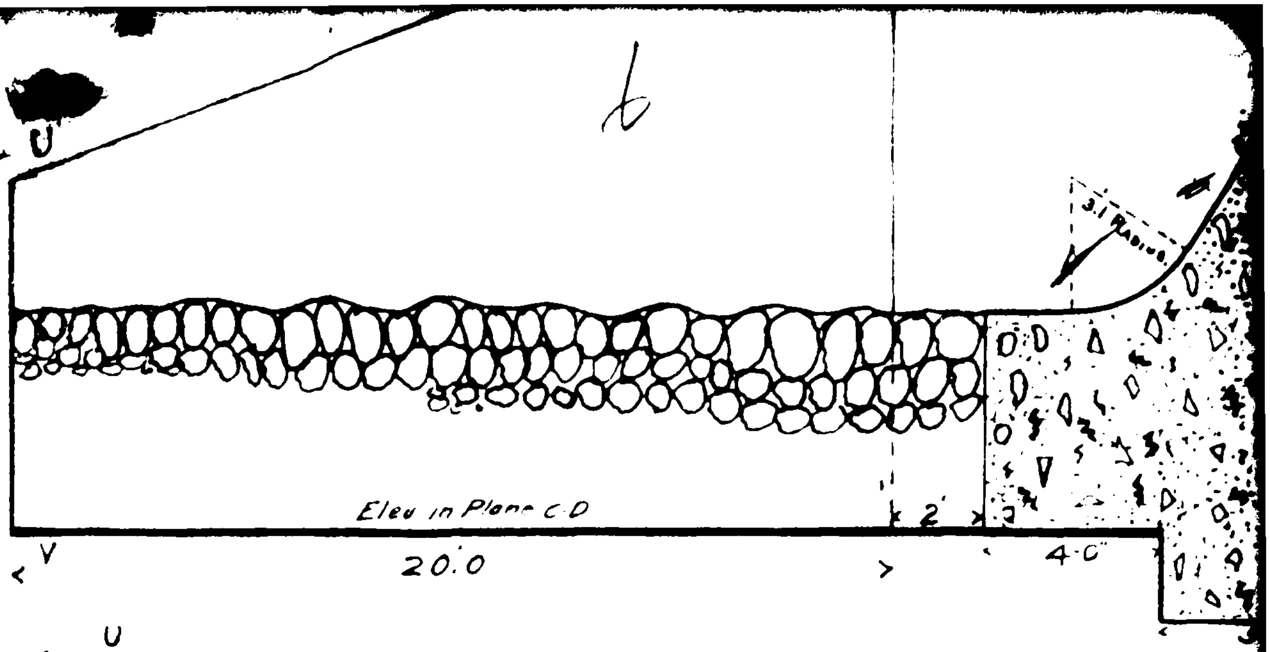
TAILS OF SPILL-WAY.

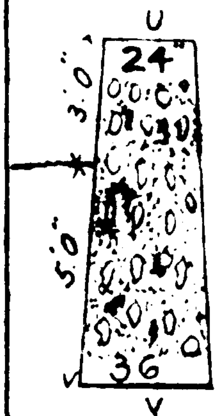
M.-D. VI.

10

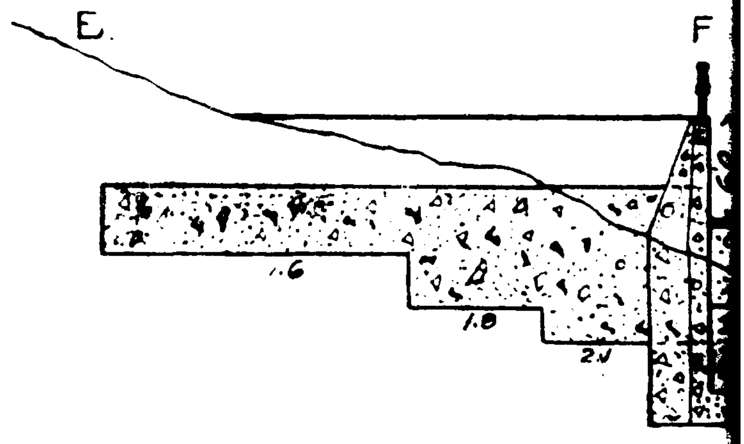


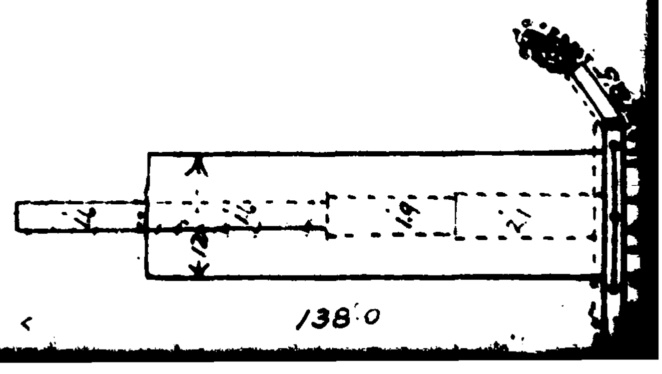
b

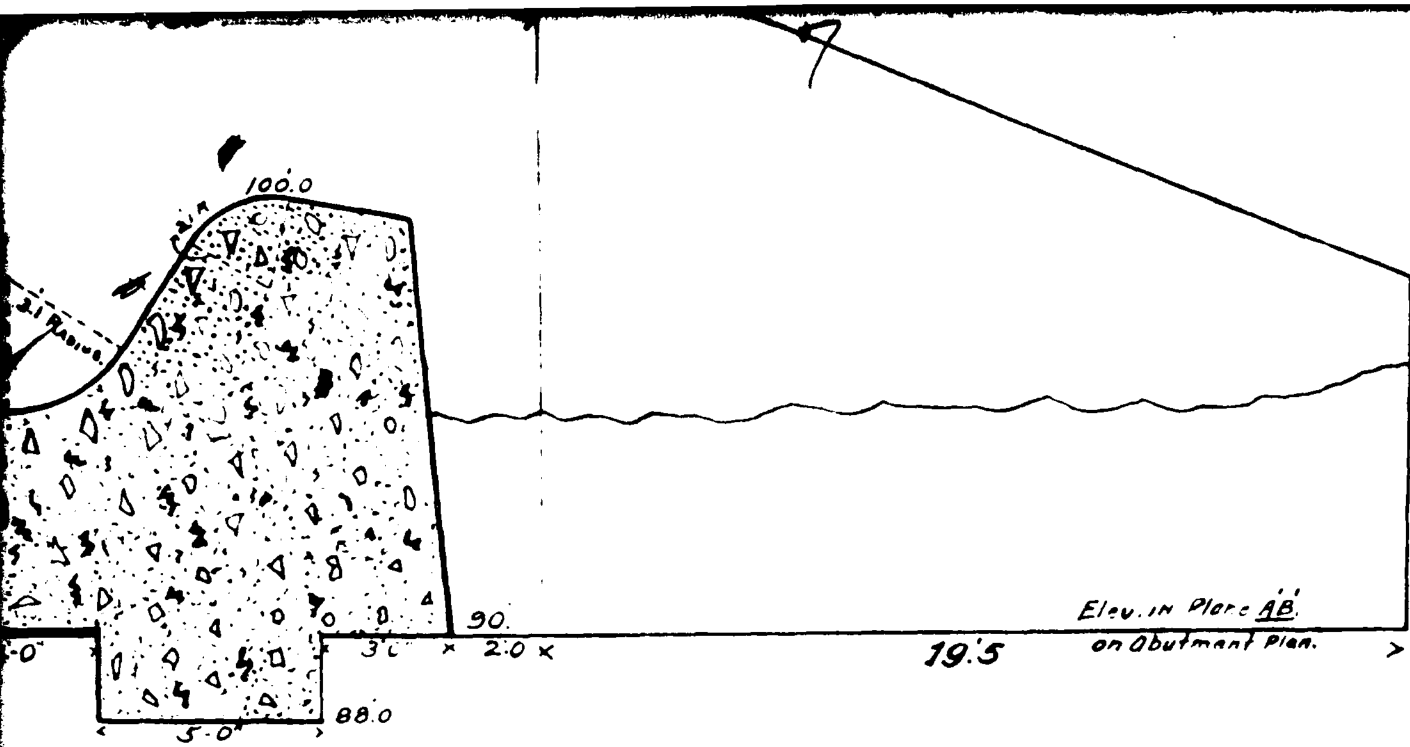




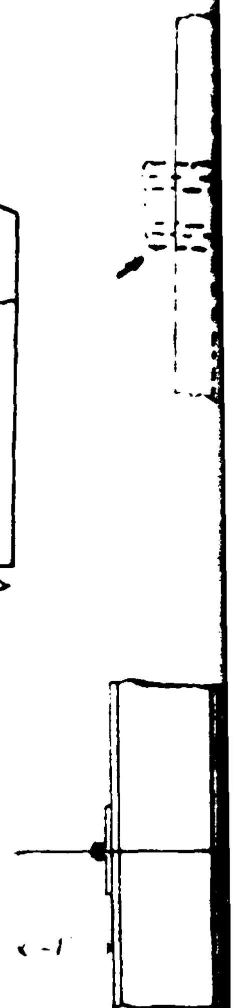
ELEVATION OF C
SPILLWA

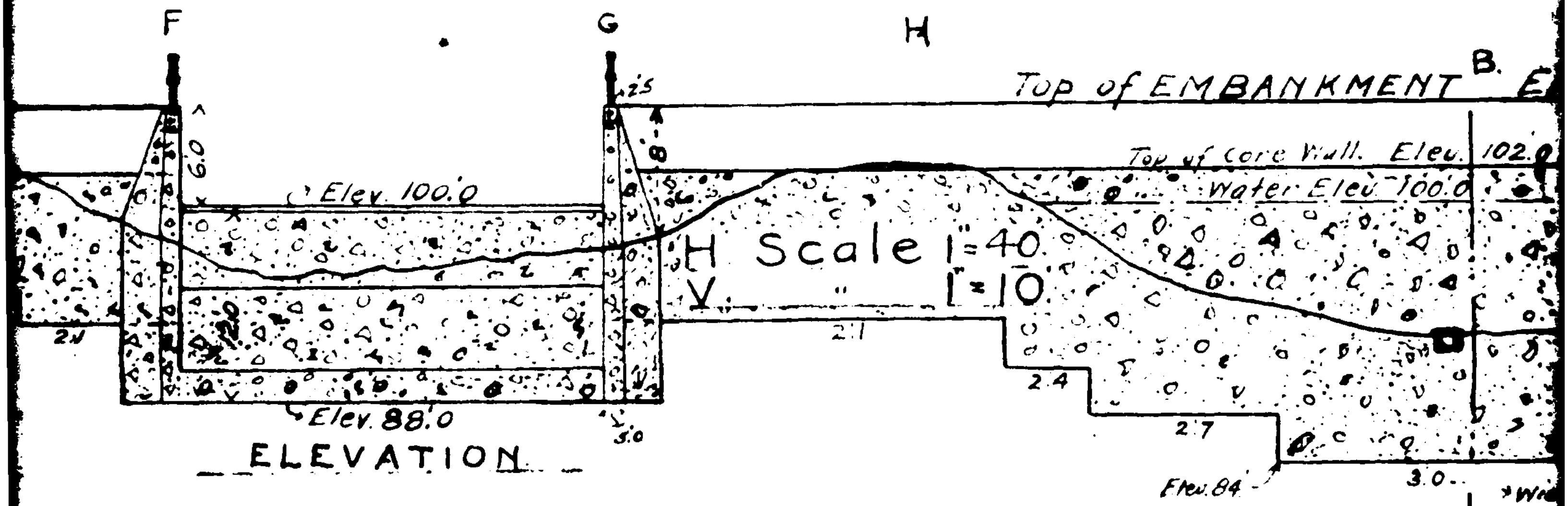




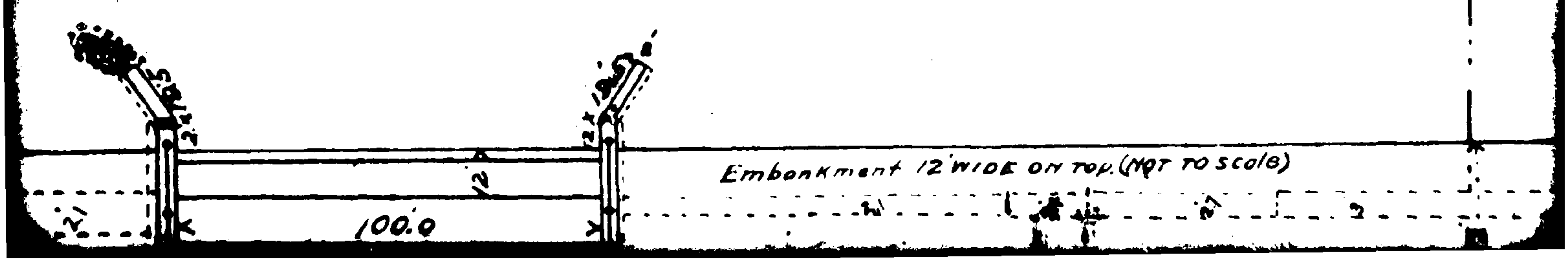


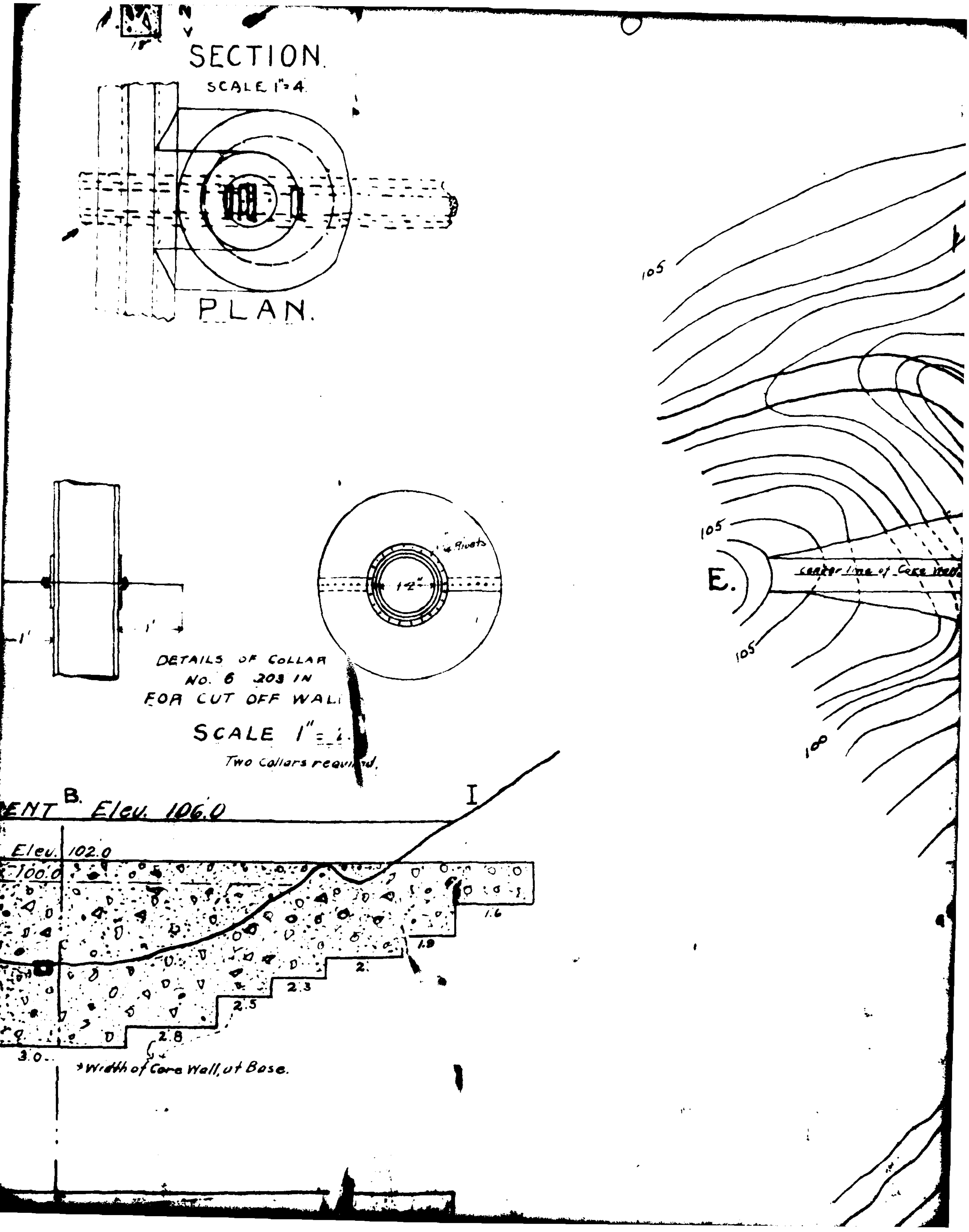
TION OF CONCRETE
SPILLWAY AND WING WALLS.
scale, 1"=4.

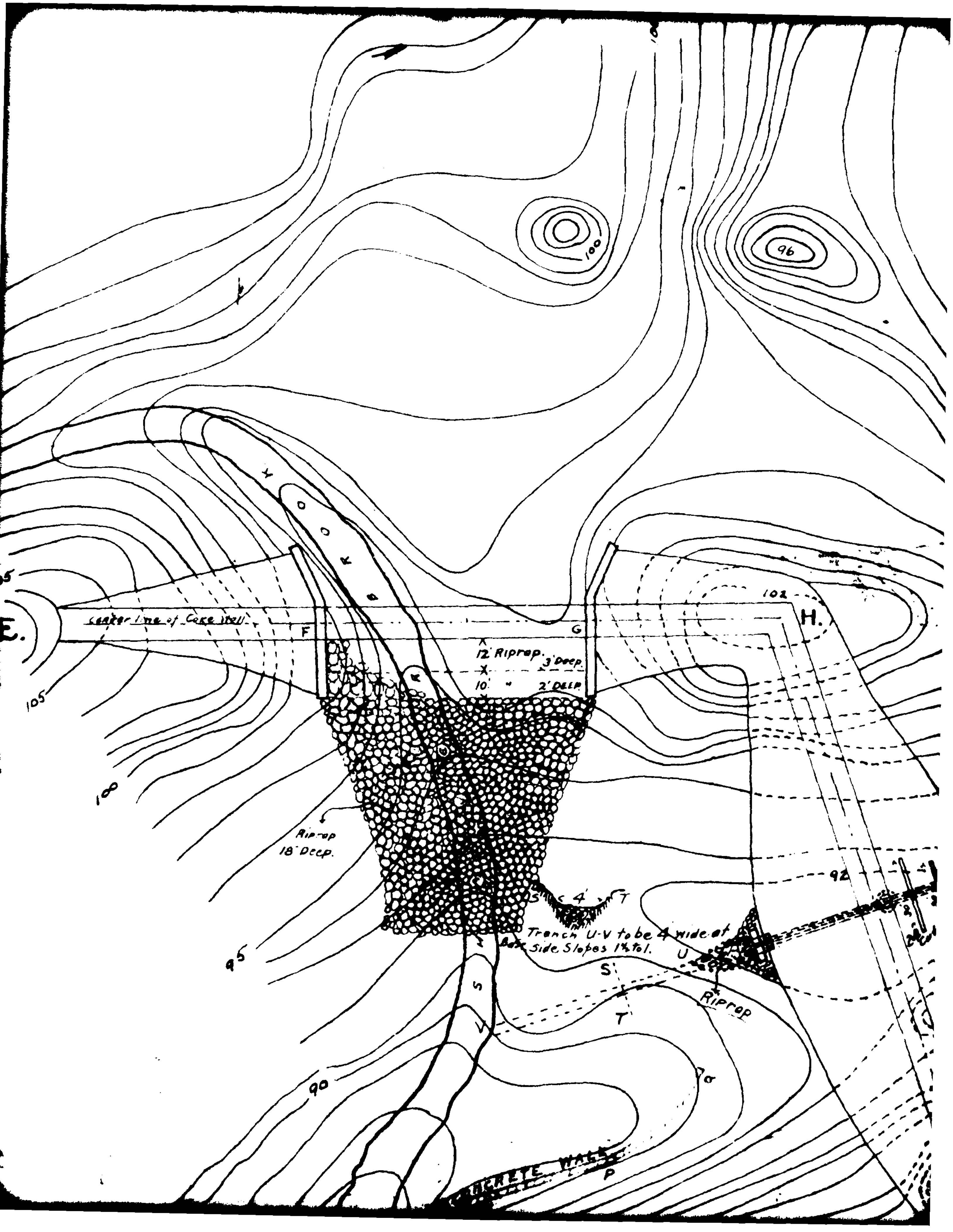




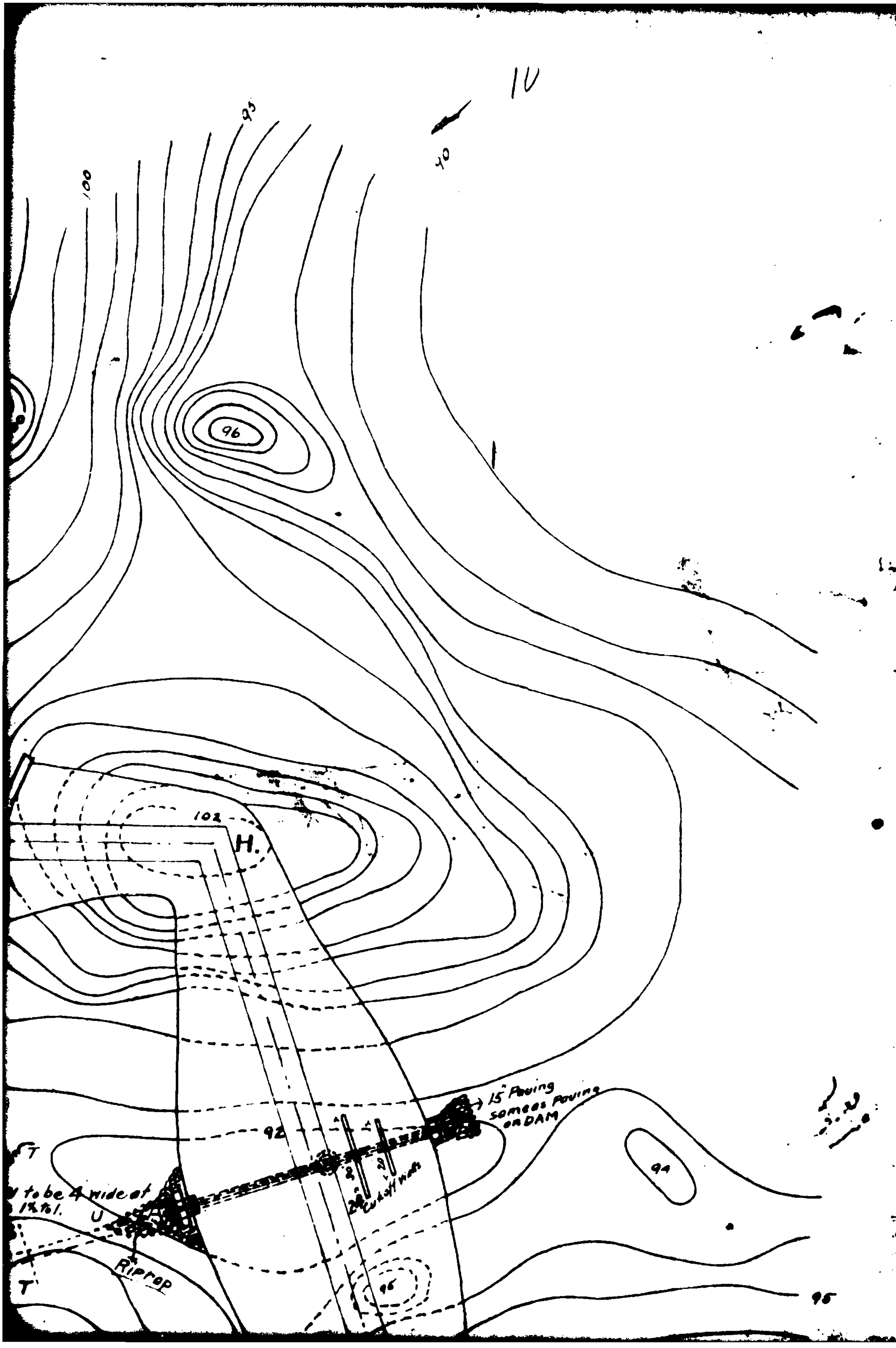
ELEVATION



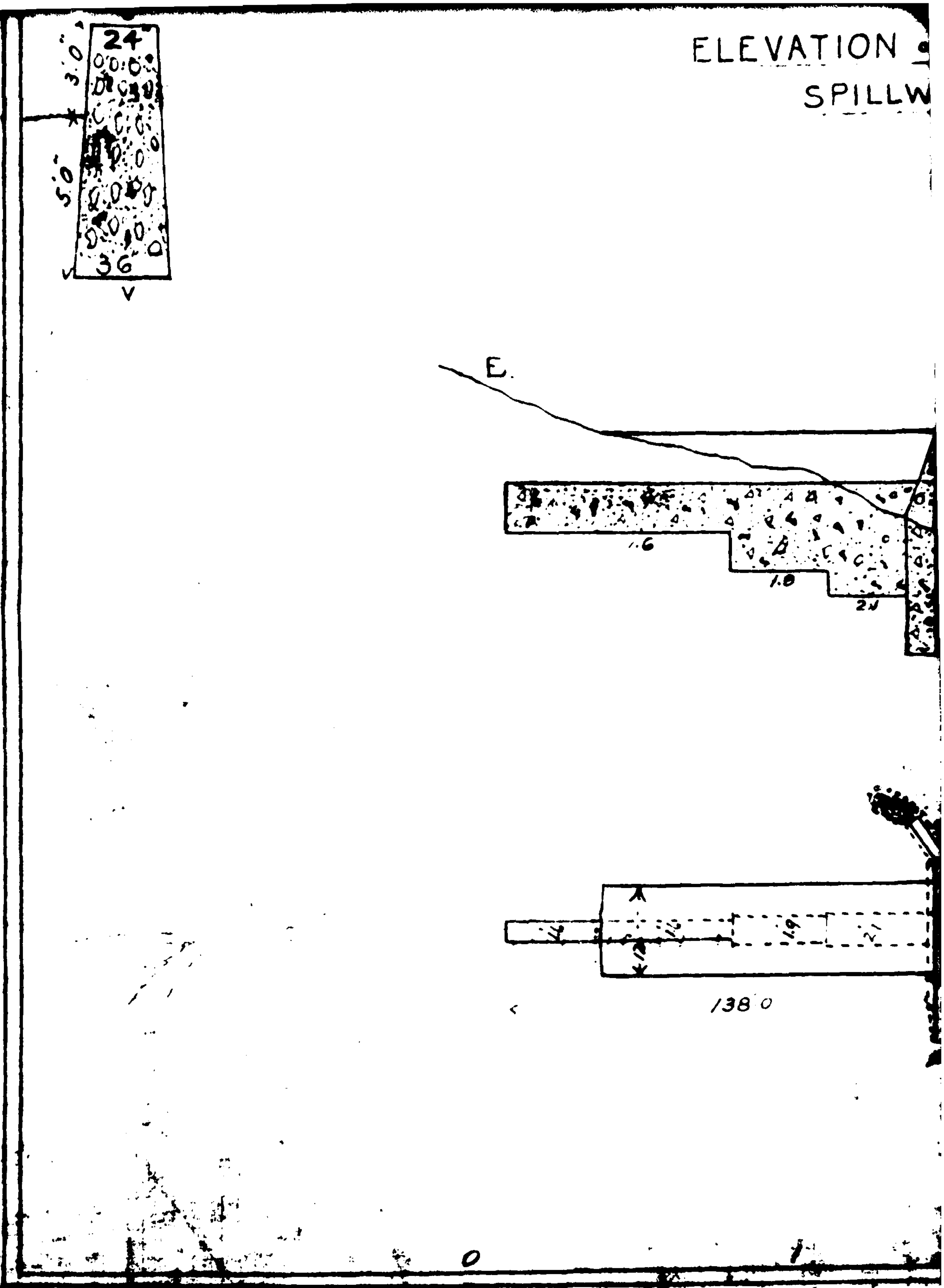

SECTION.
SCALE 1"=4.
PLAN.
14"
DETAILS OF COLLAR
No. 6 203 IN
FOR CUT OFF WAL
SCALE 1"=
Two Collars requi d.
B.
I
ENT Elev. 106.0
Elev. 102.0
100.0
1.6
1.9
2.
2.3
2.5
2.8
3.0
Width of Core Wall, at Base.
105
105
105
100
E.
center line of Core Wall



center line of Core Wall
E.
F
G
H.
102
12" Riprap. 3' Deep.
10" " 2' DEEP
Riprap
18" Deep.
105
100
96
100
95
92
90
S 4' T
Trench U-V to be 4' wide at Bot. Side Slopes 1½ to 1.
U
S
T
Riprap
CONCRETE WALL
P

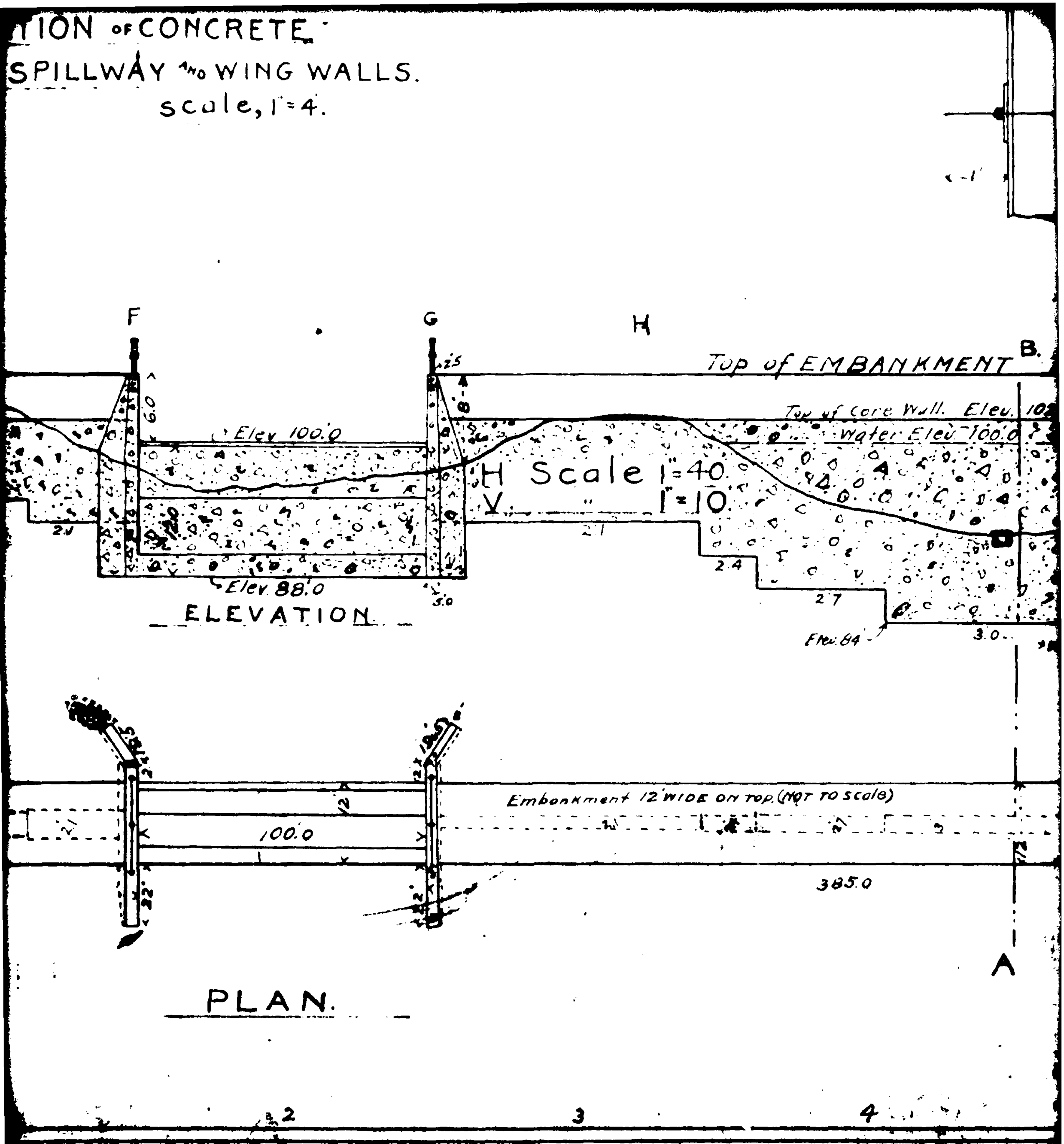


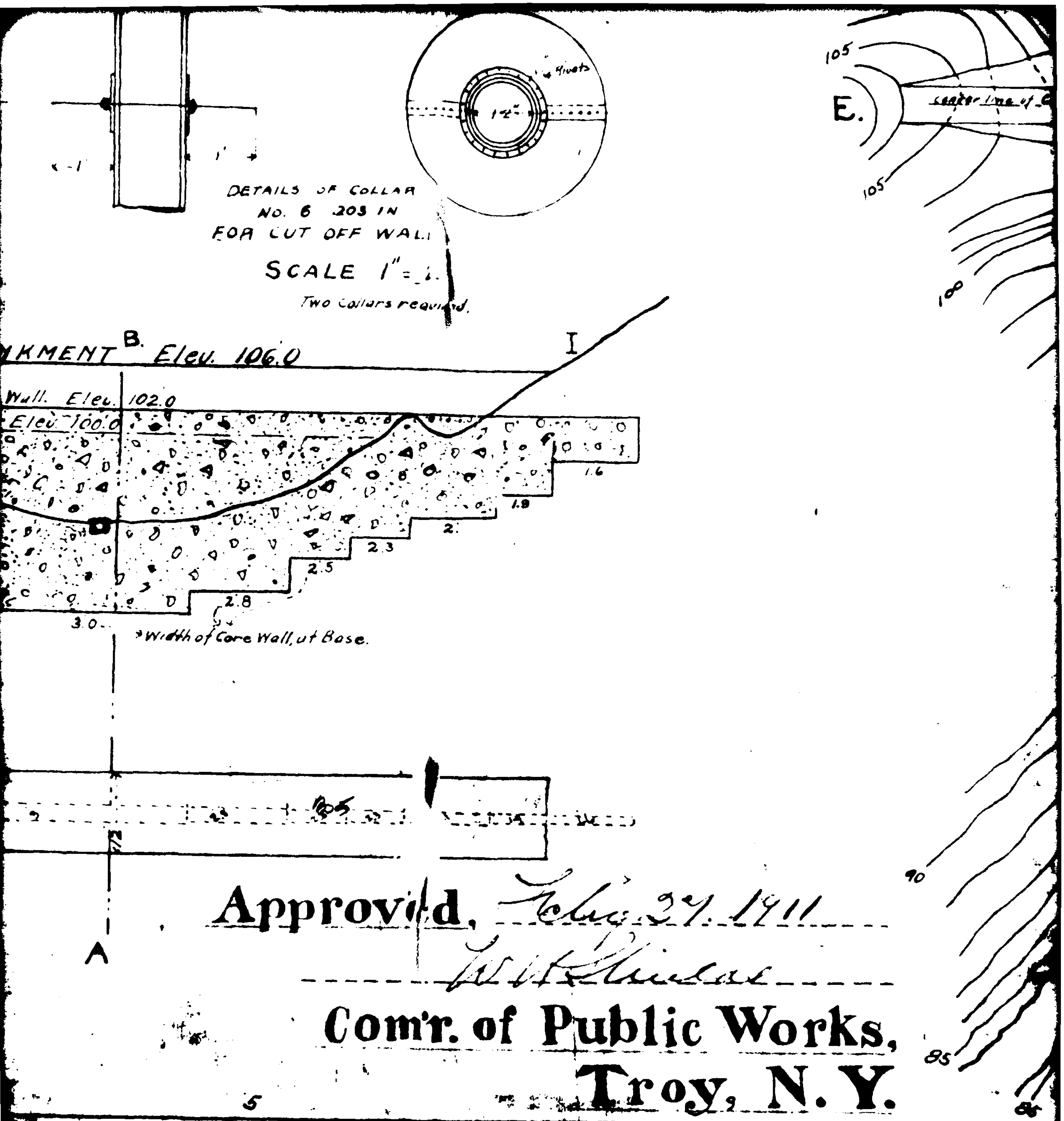
IV
95
90
100
96
102
H.
15" Paving
someas Paving
on DAM
92
T
to be 4' wide at
1½ to 1.
U
Cut off walls
Riprap
T
94
96
95



ELEVATION
SPILLW
24
3.0
5.0
36
E.
1.6
1.8
2.1
1.4
1.0
1.9
2.1
1.0
138.0
0

...TION OF CONCRETE SPILLWAY AND WING WALLS.
scale, 1"=4.

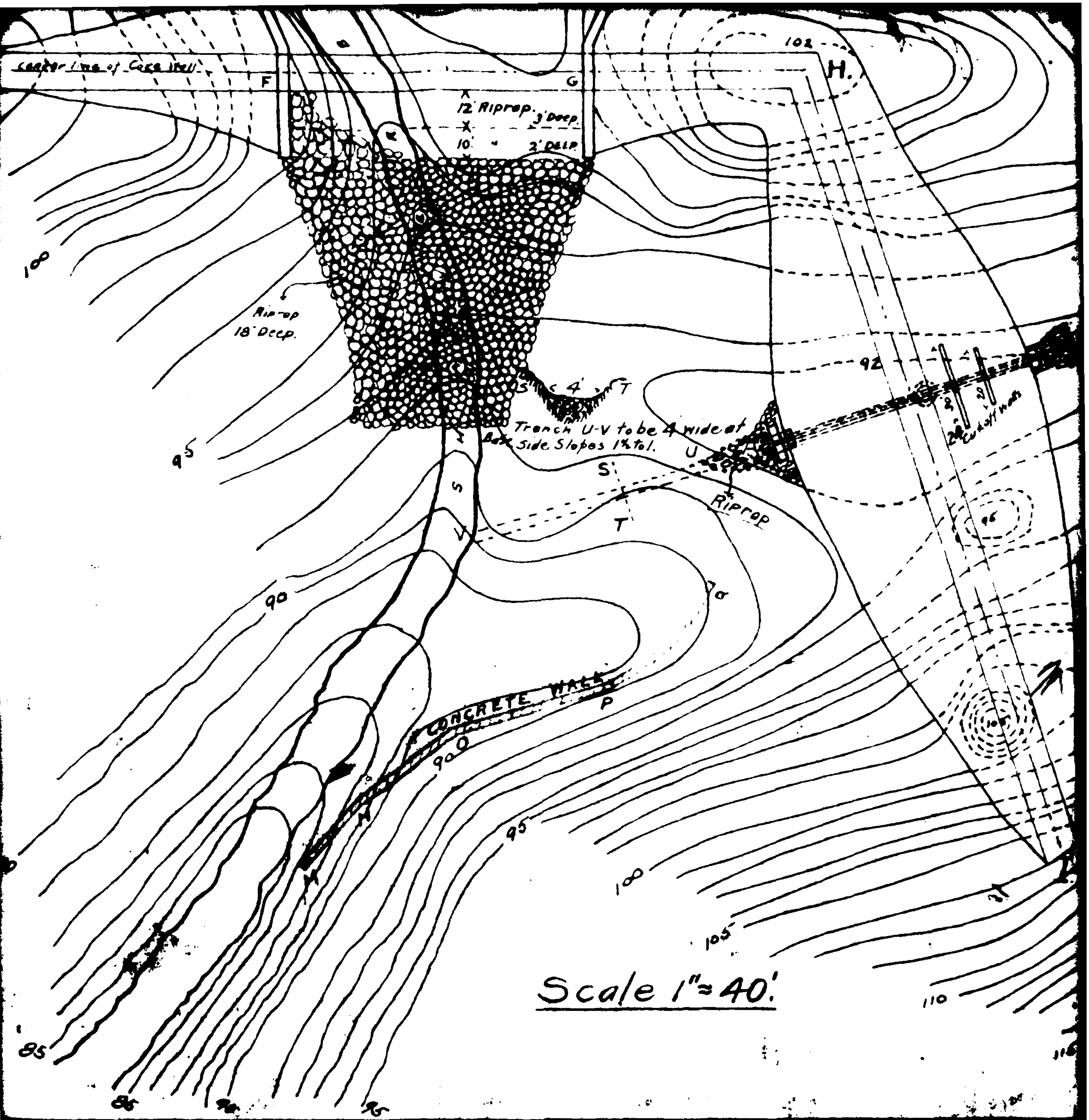


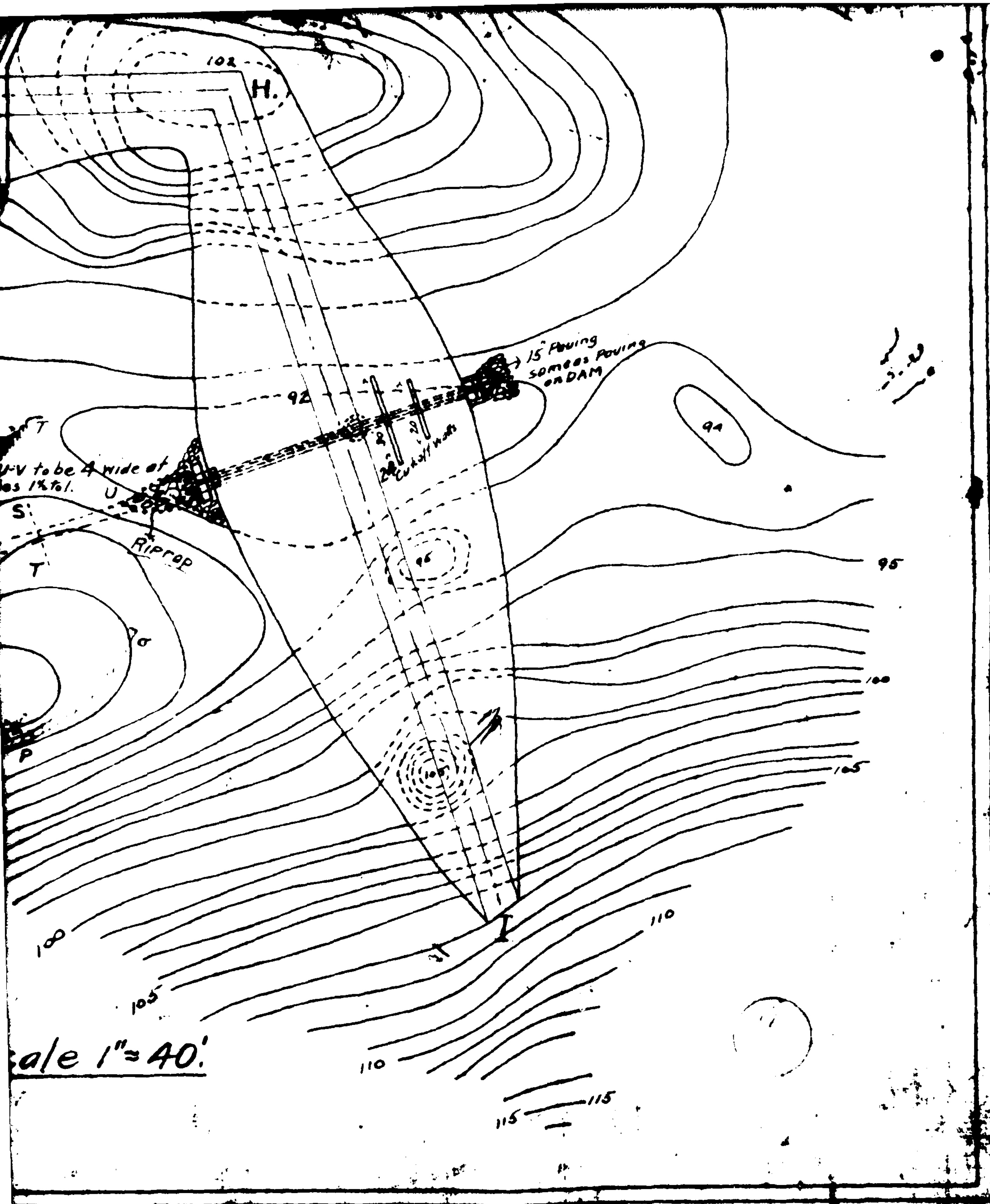


Approved, Feby. 24. 1911

[illegible signature]

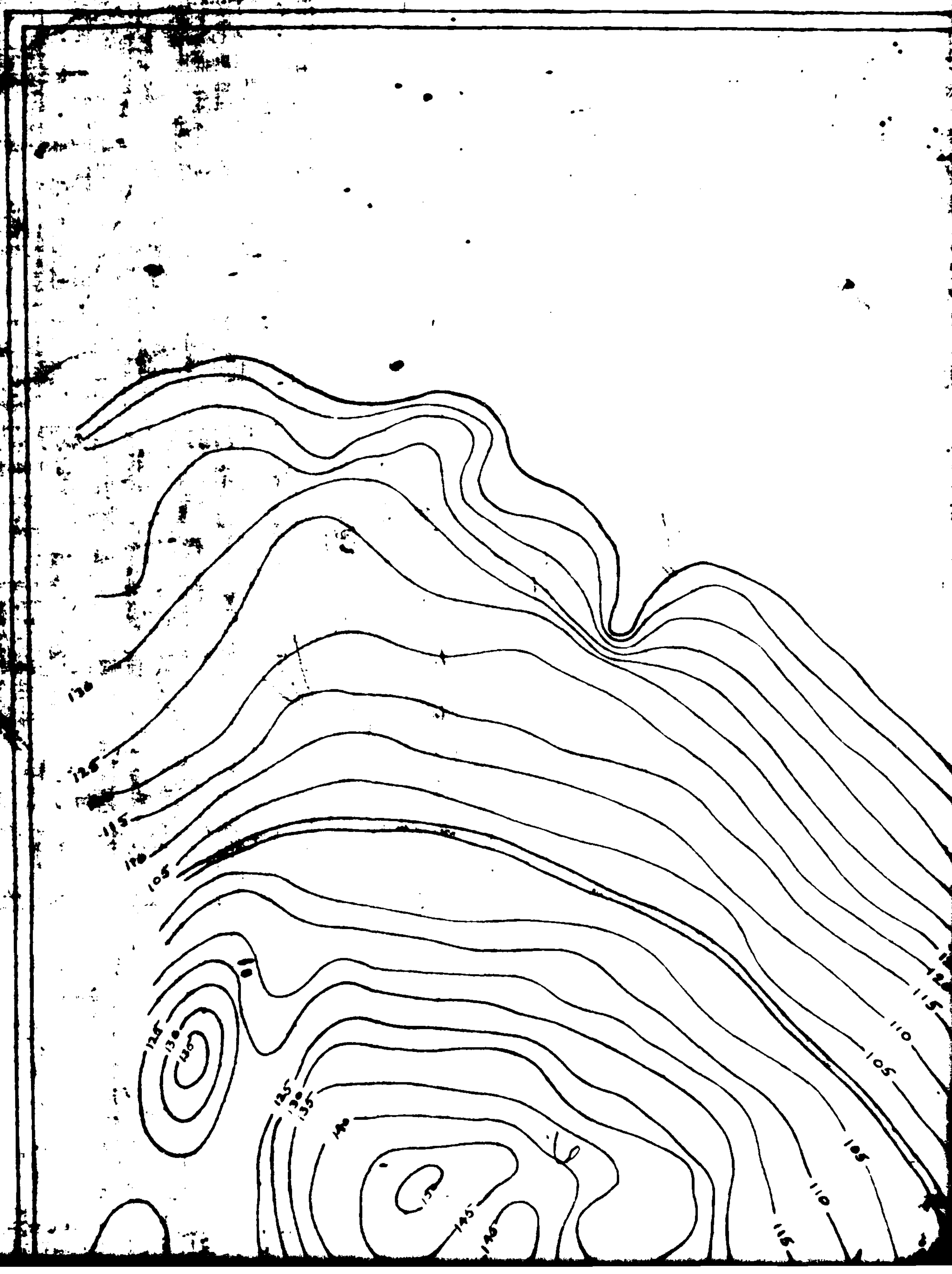
Com'r. of Public Works,
Troy, N.Y.


center line of Core Wall
F
G
H.
102
12 Riprap. 3' Deep
10 " 2' Deep
100
Rip-rap 18" Deep.
95
4'
T
Trench U-V to be 4' wide at Base Side Slopes 1½ to 1.
U
S
T
Riprap
92
Cut-off Walls
90
CONCRETE WALL
P
O
90
95
100
105
110
85
Scale 1" = 40'.



[redacted]

1 15

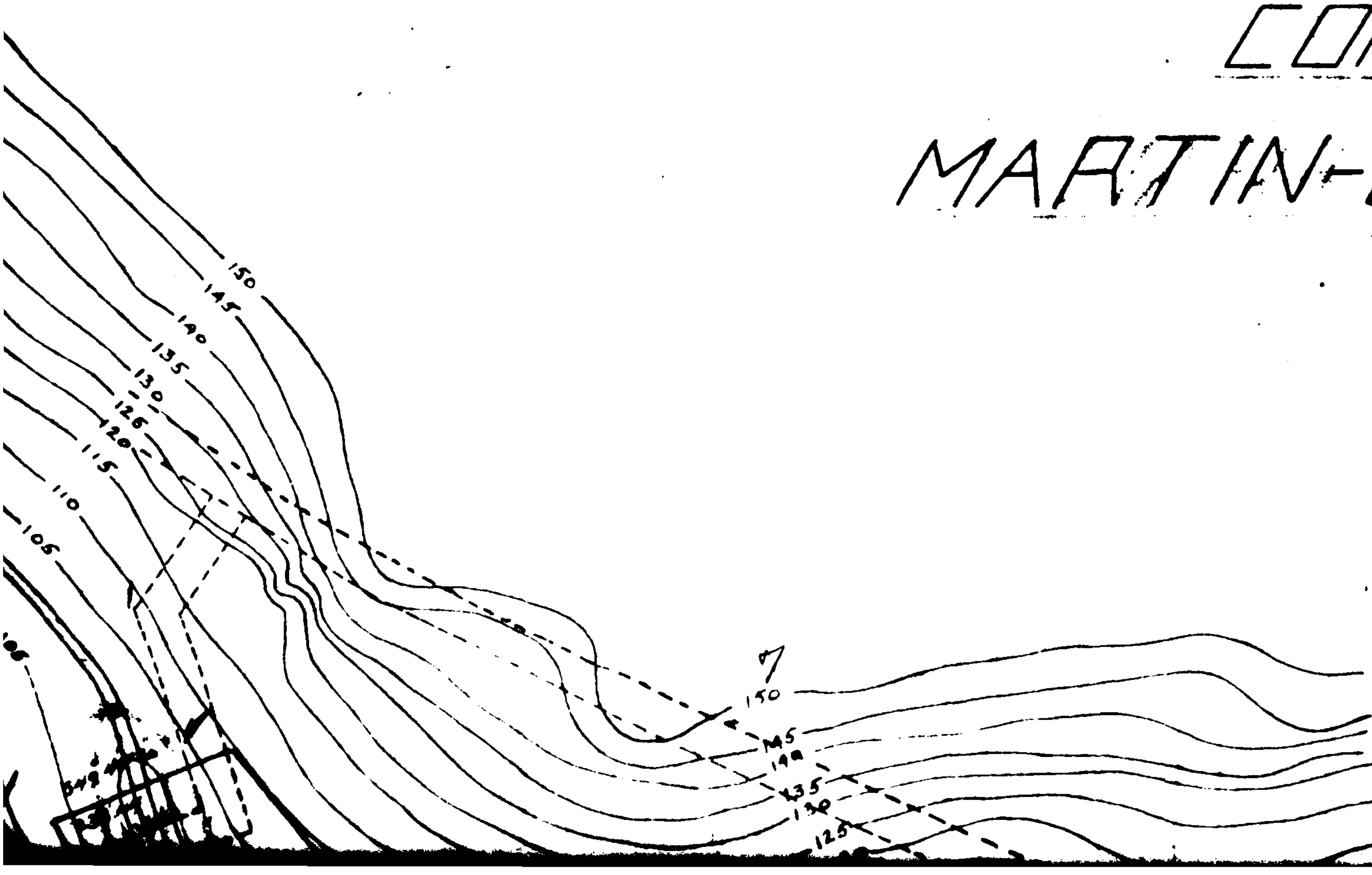

130
125
115
110
105
120
115
110
105
105
110
115
125
130
135
140
145
140

TR

CON

MARTIN-

S



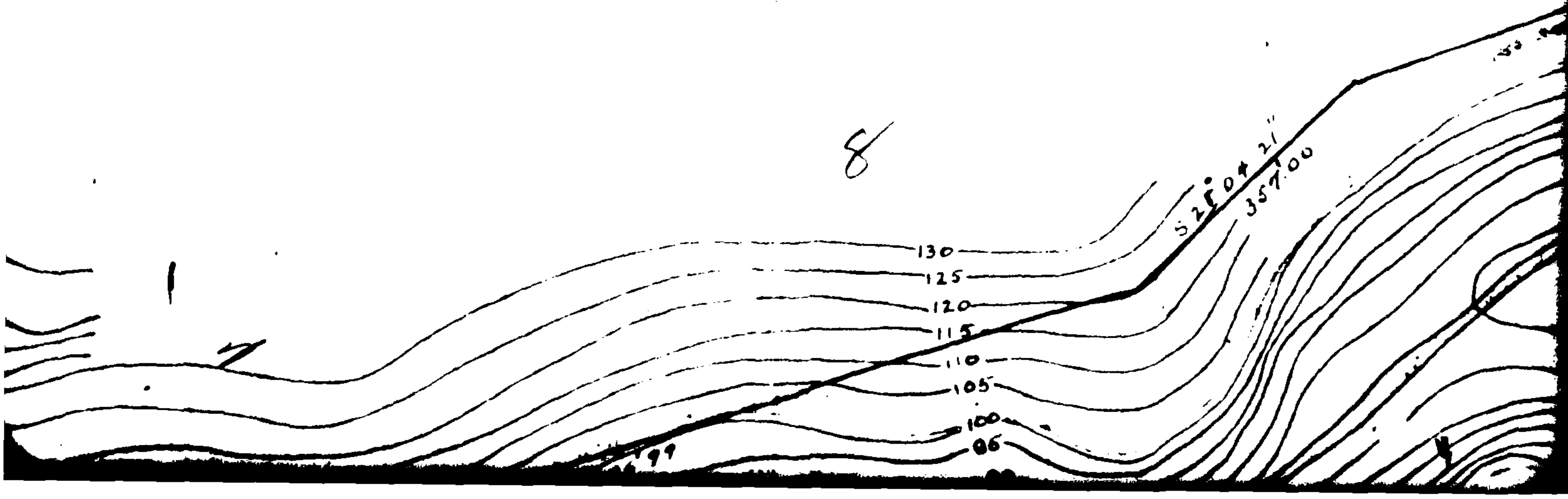
3

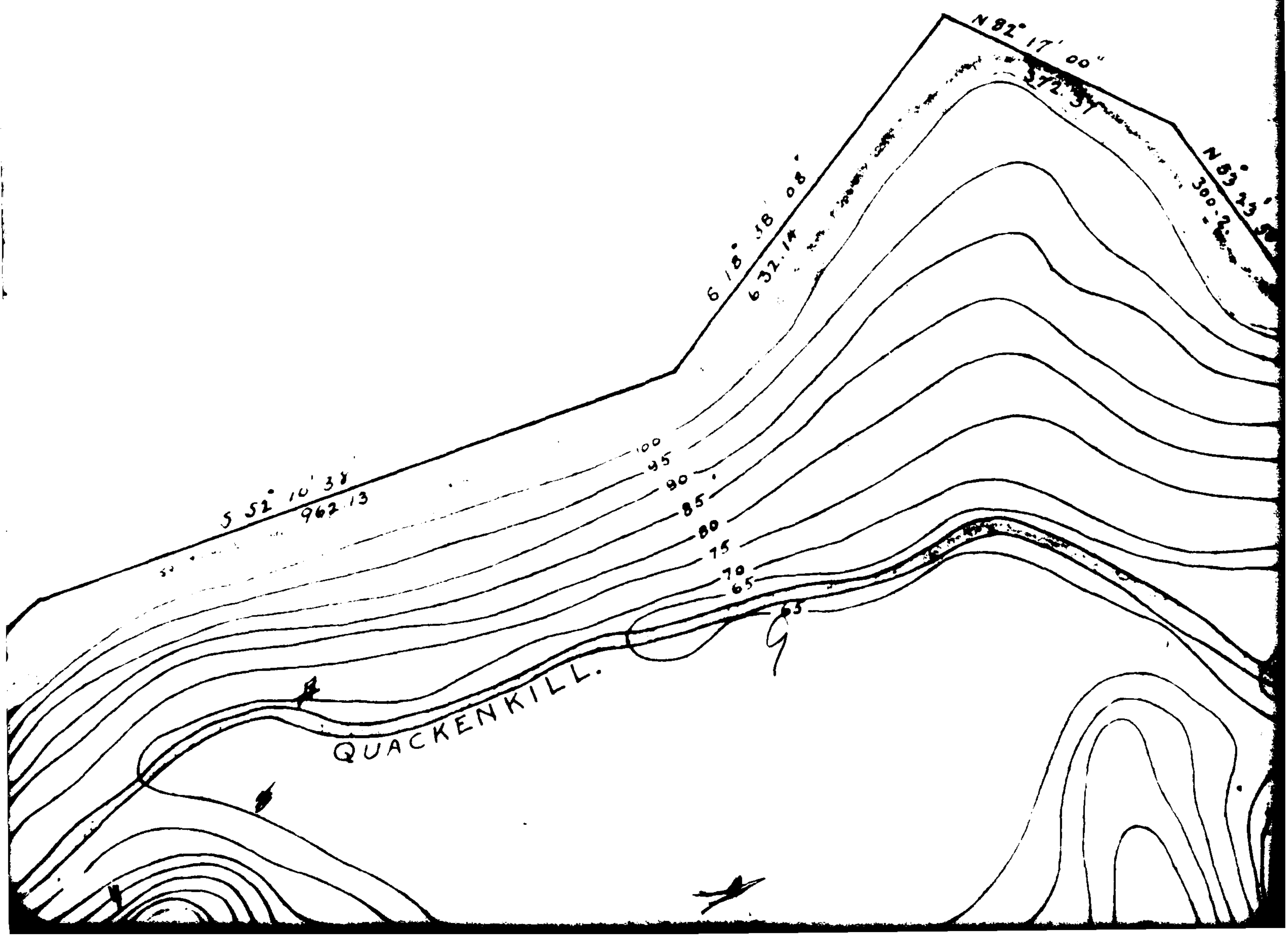
TROY WATER WORKS EXTENSION.

ONTOUR MAP OF
-DUNHAM-RESERVOIR.

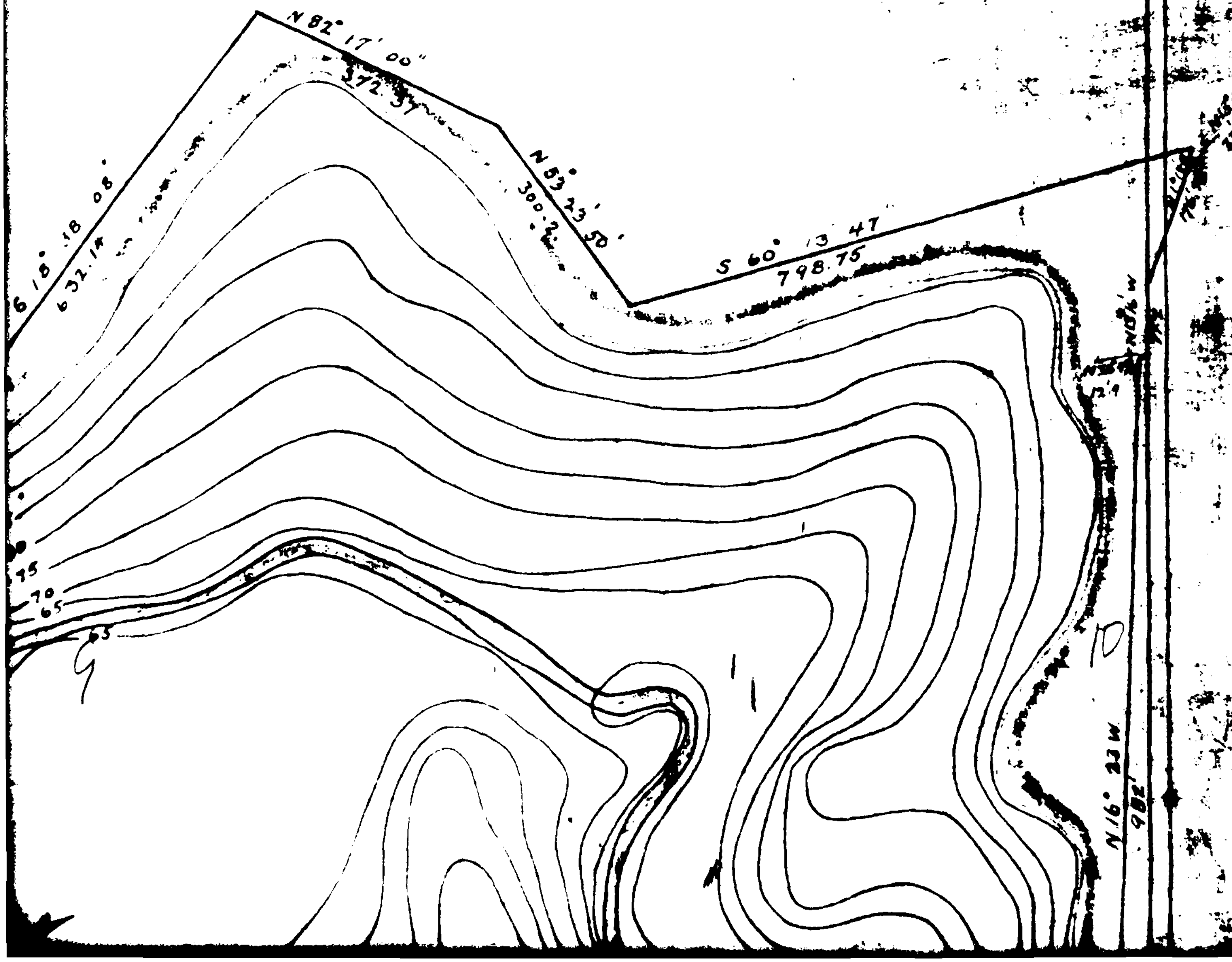
SCALE, 1" = 200

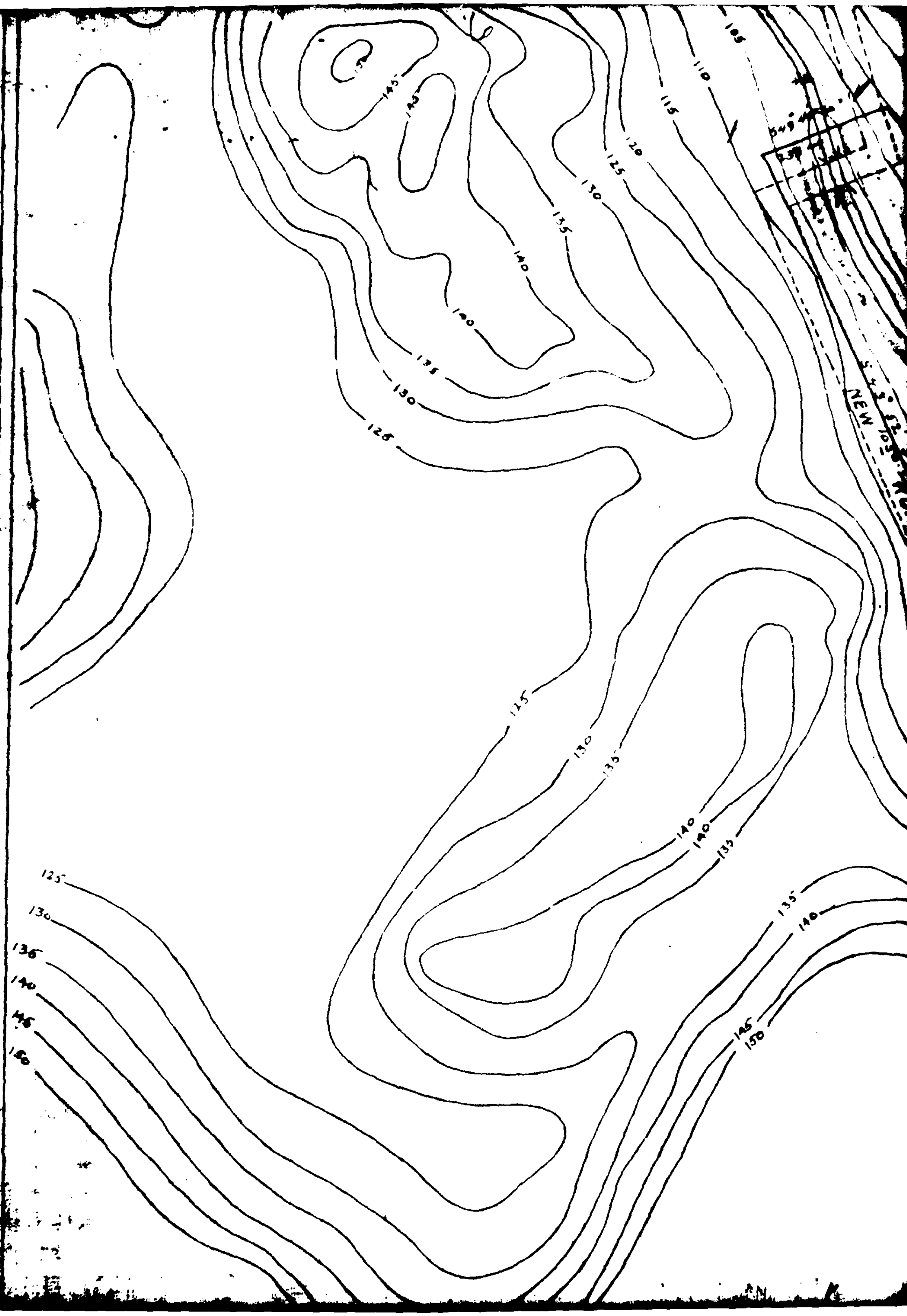
8

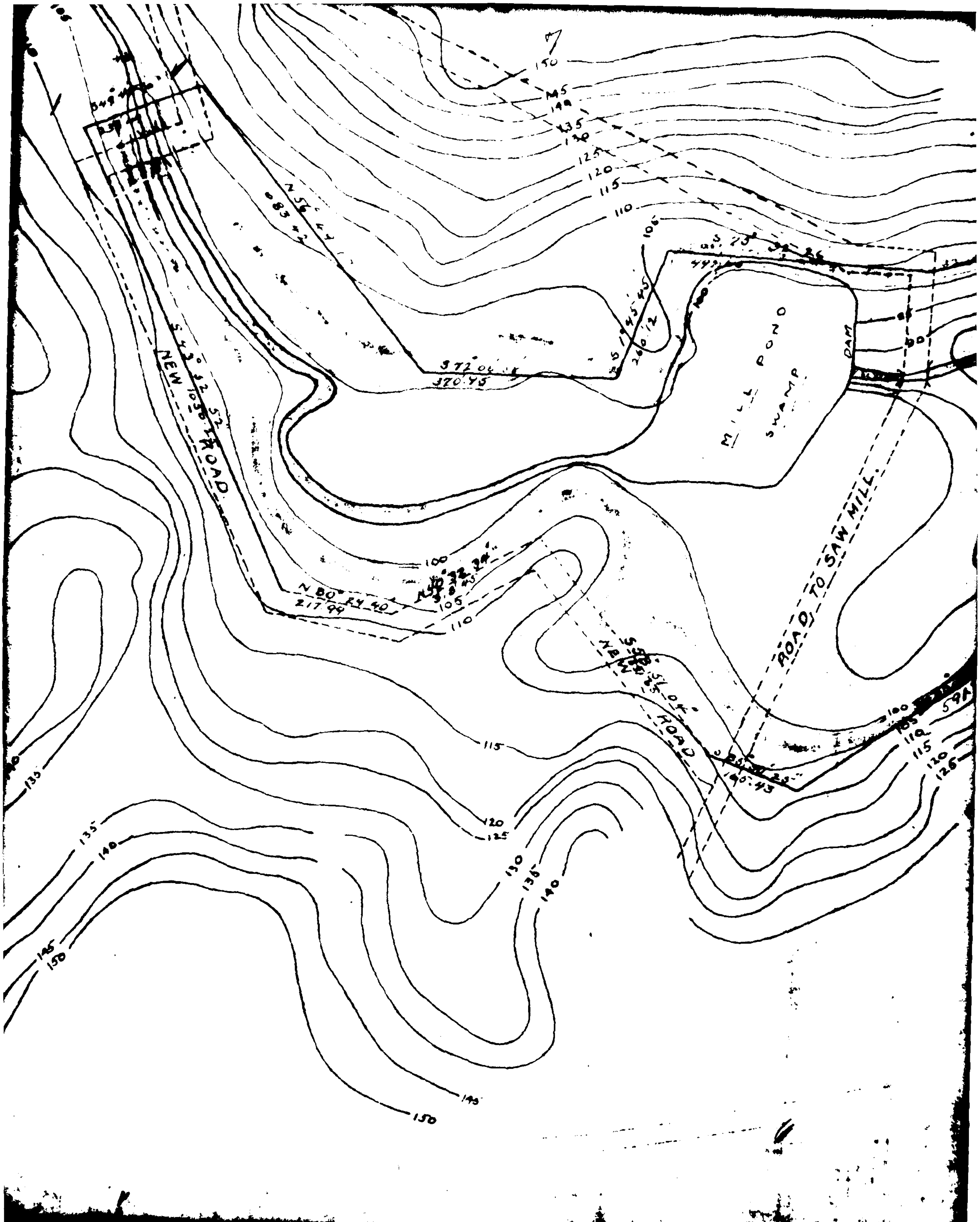



N 82° 17' 00"
S 18° 38' 08"
632.14
S 52° 10' 38"
962.13
100
95
90
85
80
75
70
65
63
QUACKENKILL.

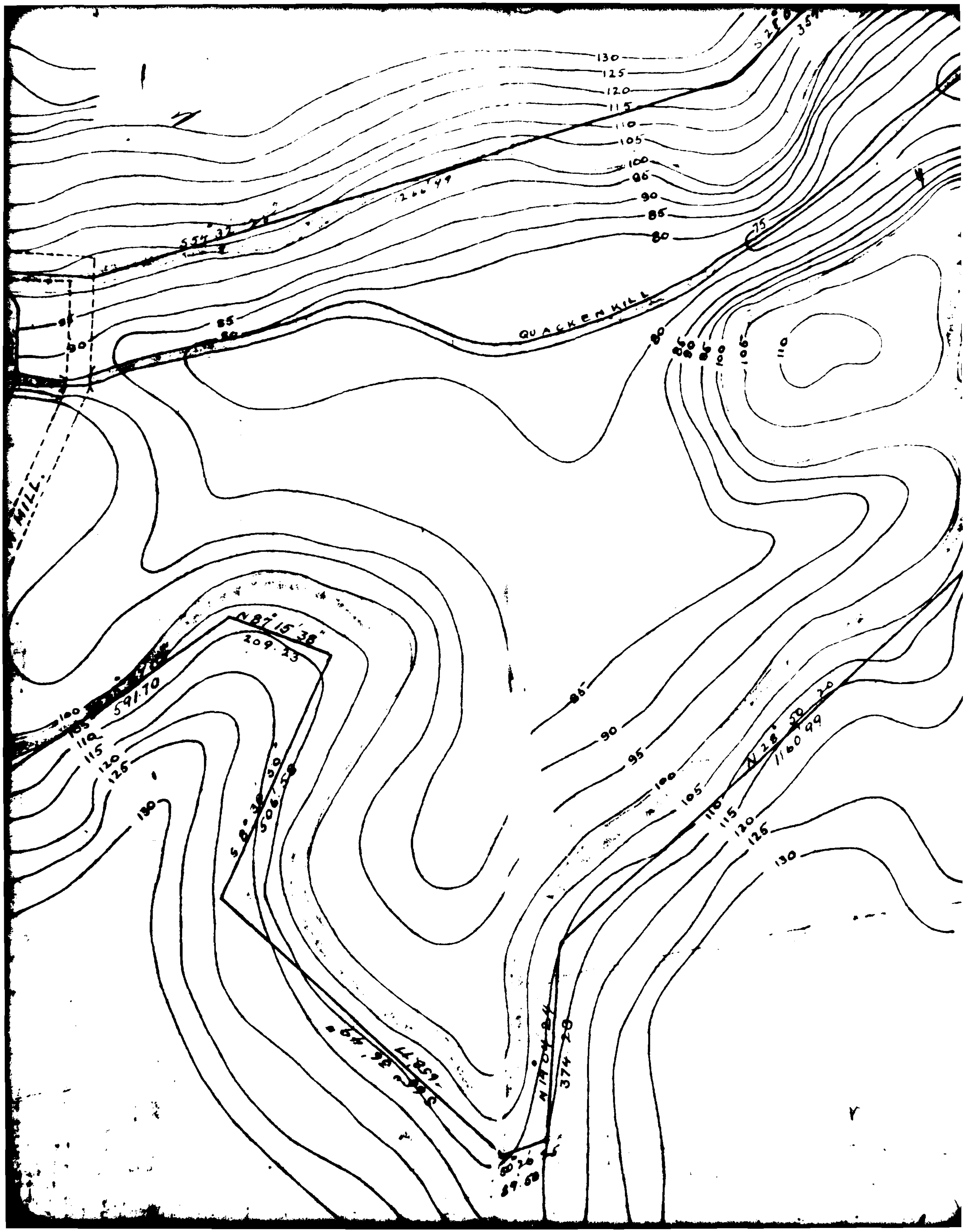
M-D.VII.

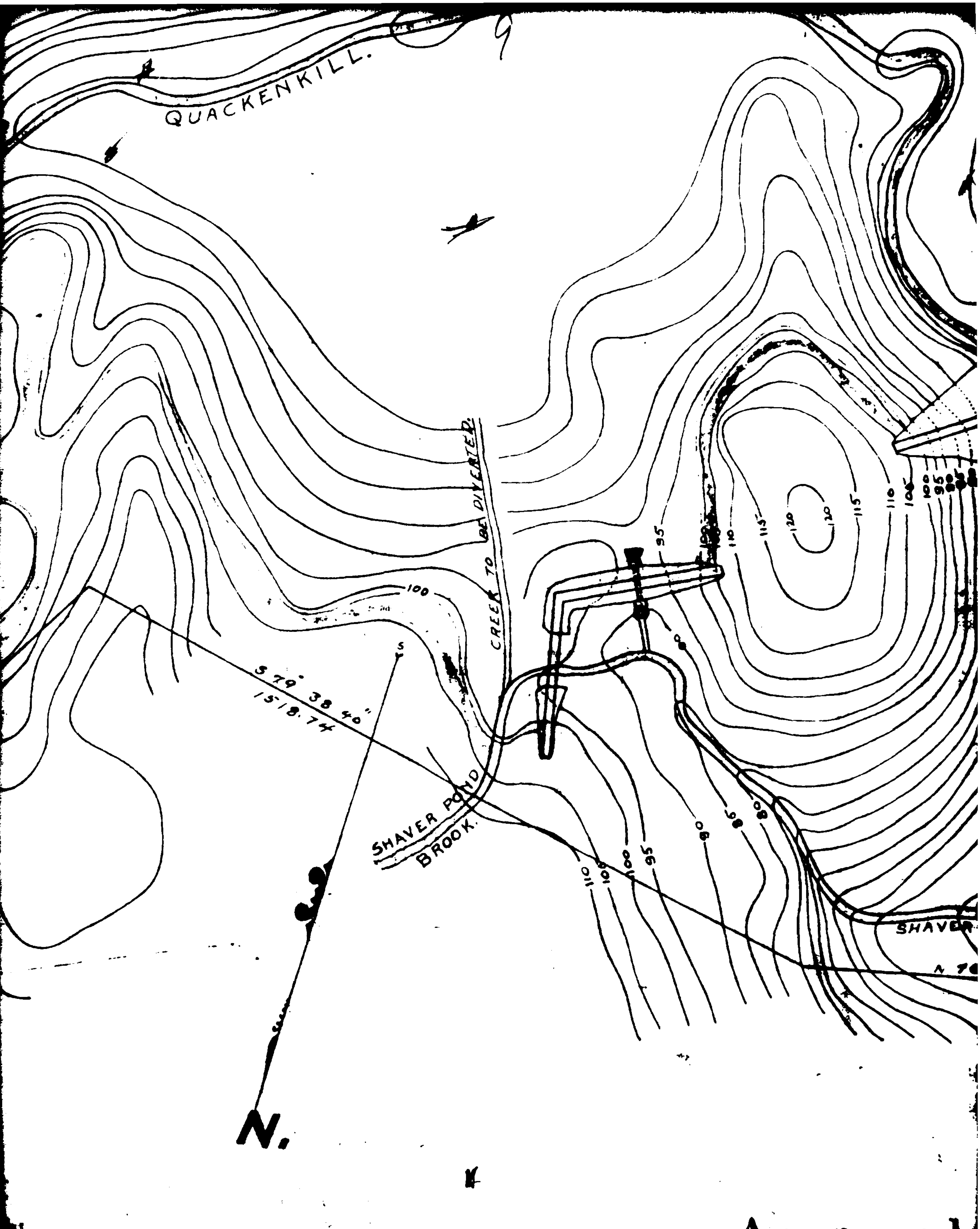

N 82° 17' 00"
372.37
N 53° 23' 50'
300.2
S 60° 13' 47
798.75
632.14
75
70
65
63
9
10
N 16° 23 W
982'


105
110
115
120
125
130
135
140
145
145
140
140
135
130
125
NEW
125
130
135
140
140
135
135
140
145
150
125
130
135
140
145
150

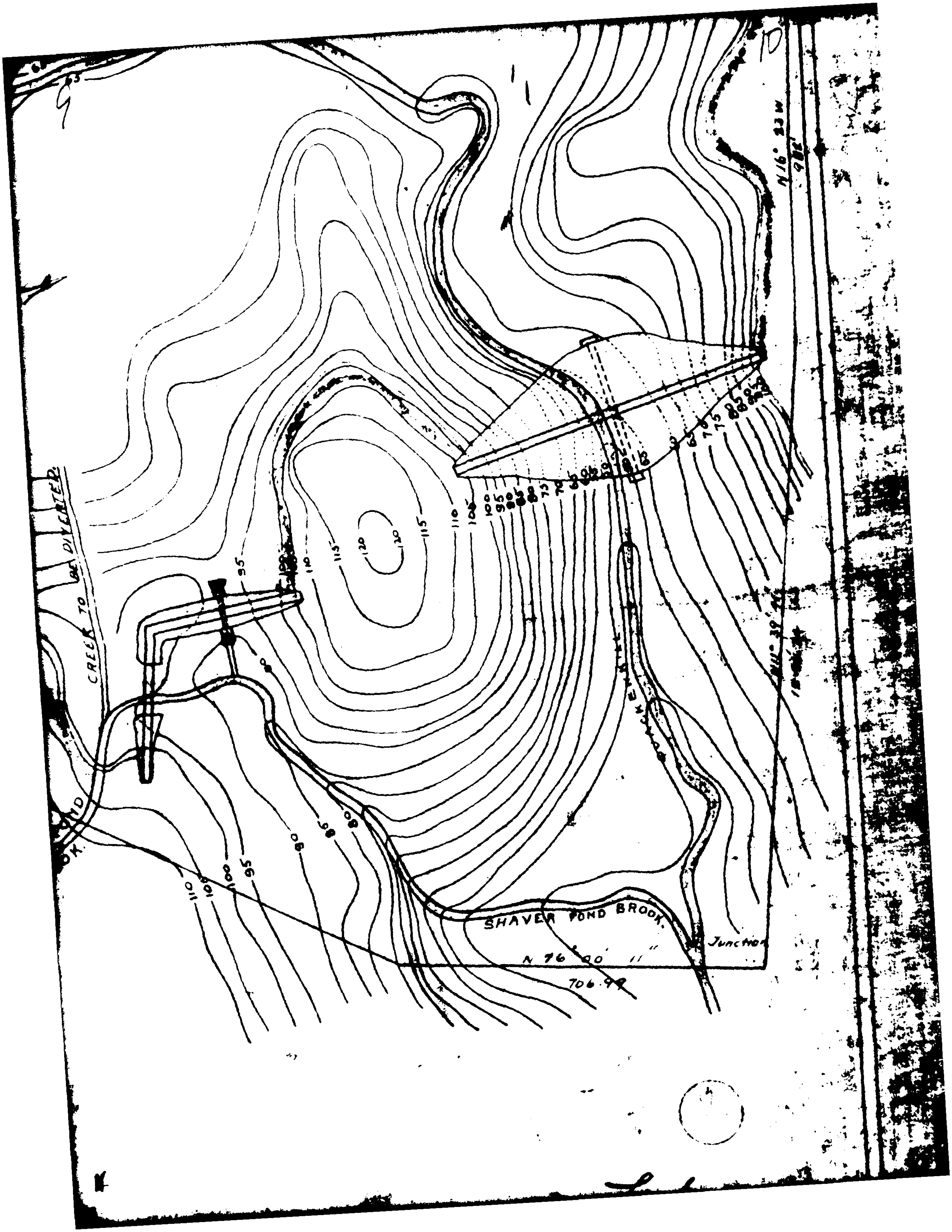


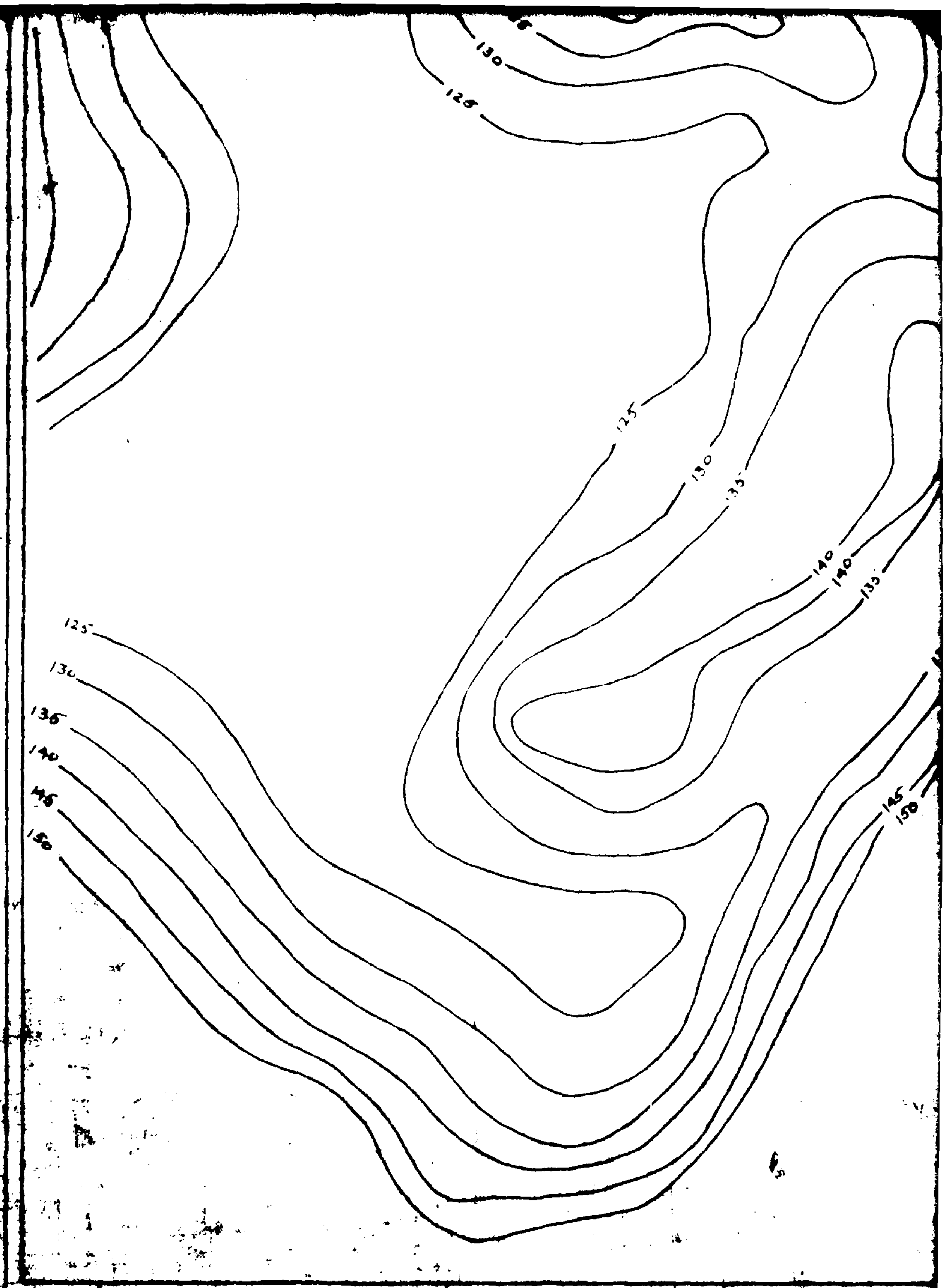
NEW ROAD
MILL POND
SWAMP
DAM
ROAD TO SAW MILL.
NEW ROAD
370.75
217.99
N 80° 24' 40"
150
145
140
135
130
125
120
115
110
105
100


130
125
120
115
110
105
100
95
90
85
80
75
1266.49
QUACKENKILL
MILL
110
105
100
N87°15'38"
209.23
591.70
506.58
85
90
95
100
105
110
115
120
125
130
1160.99
374.28
89.68

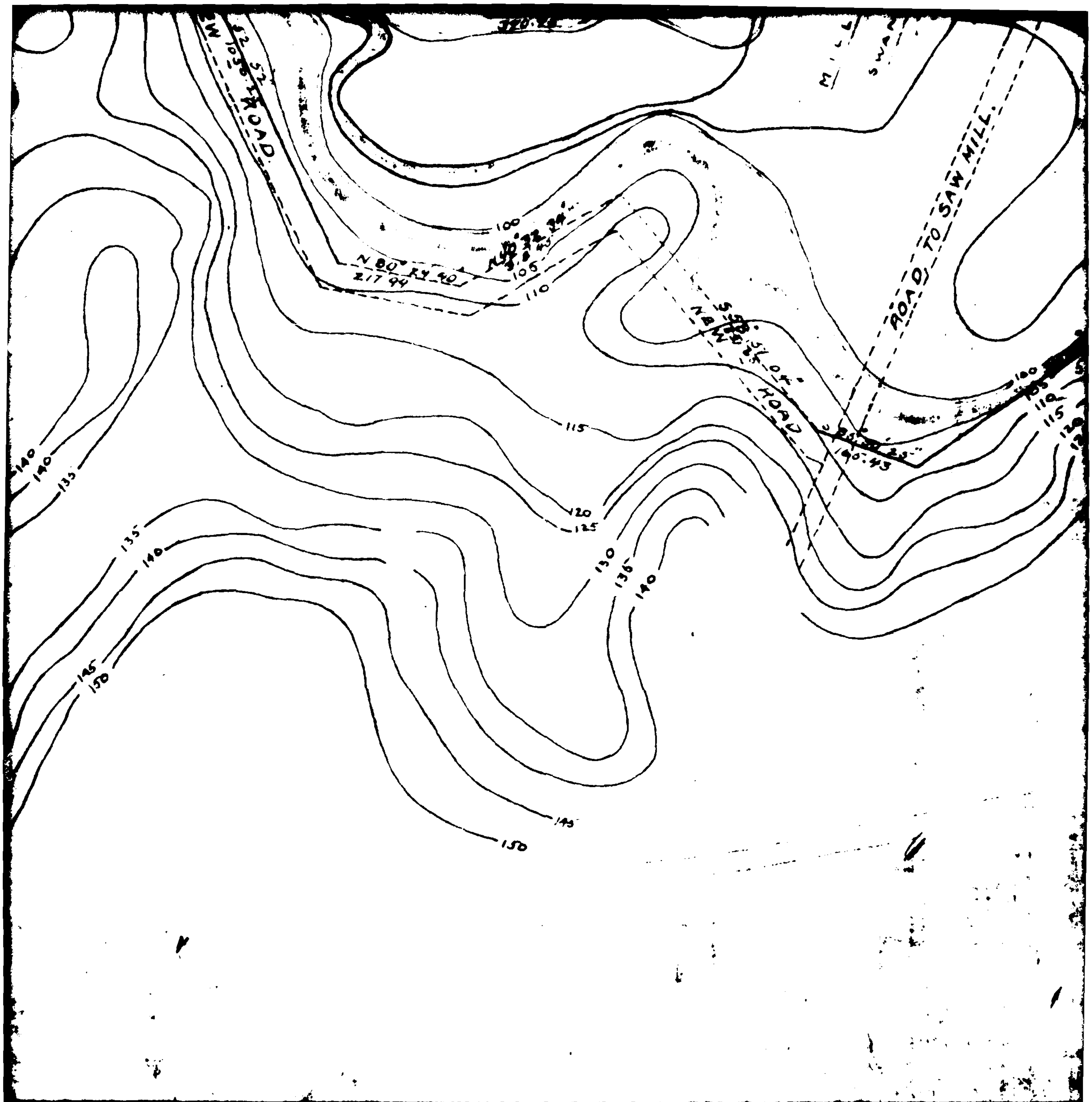

QUACKENKILL.
CREEK TO BE DIVERTED.
100
S 79° 38' 40"
1518.74
SHAVER POND
BROOK.
95
100
110
115
120
120
115
110
105
100
95
110
105
100
95
90
85
80
SHAVER
N.

Approved

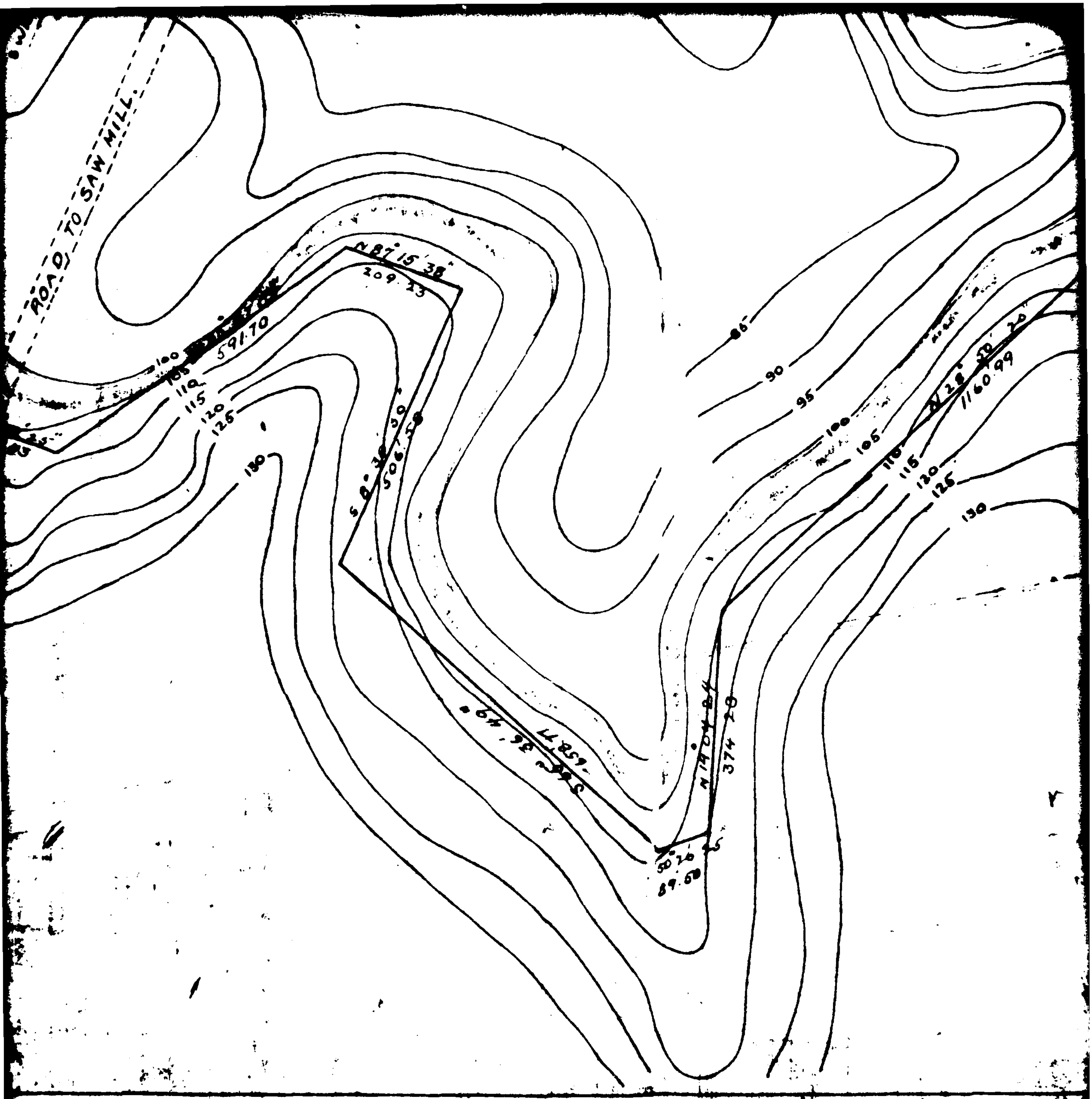

CREEK TO BE DIVERTED
SHAVER POND BROOK
Junction

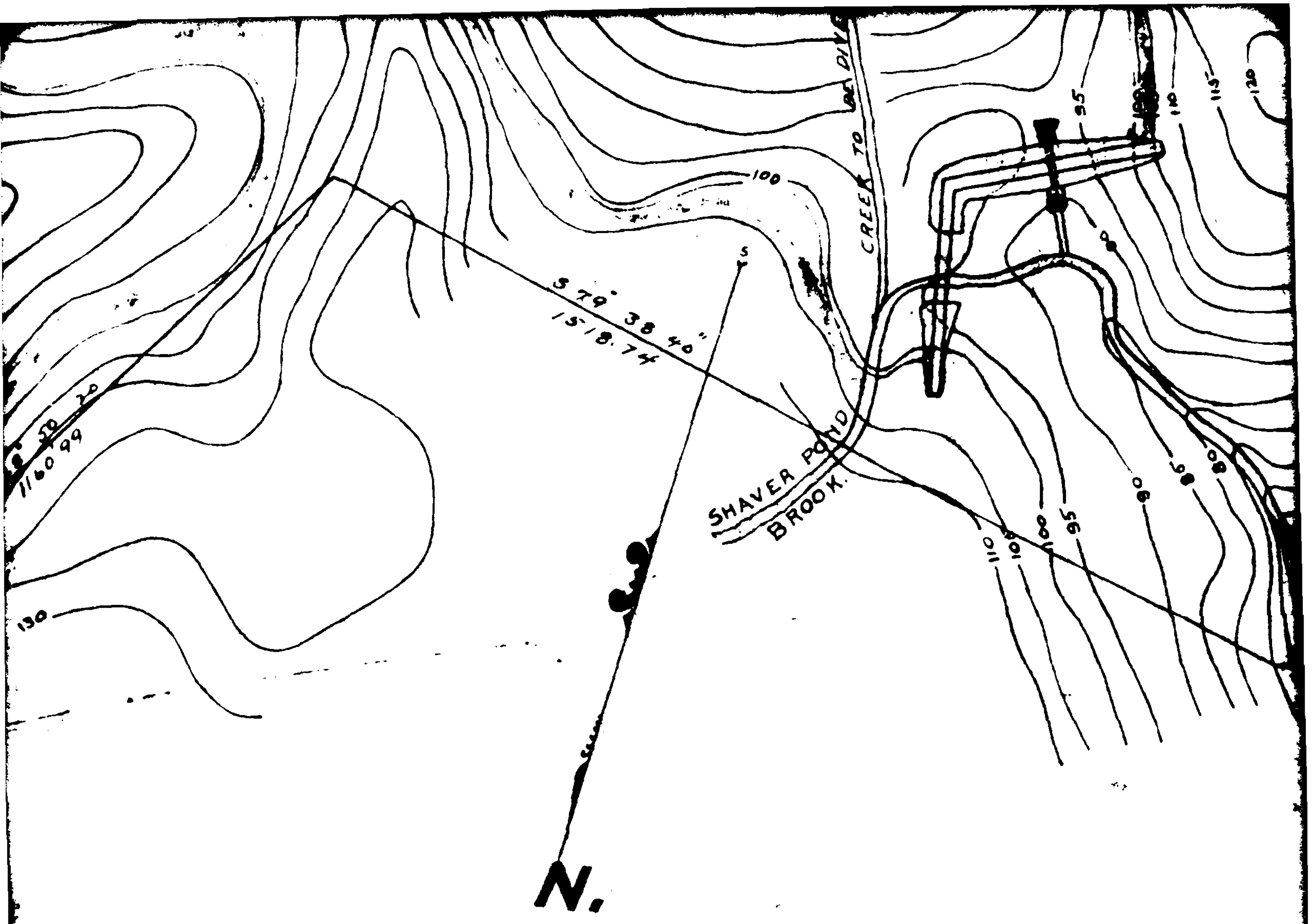


130
125
125
130
135
140
140
135
125
130
135
140
145
150
145
150



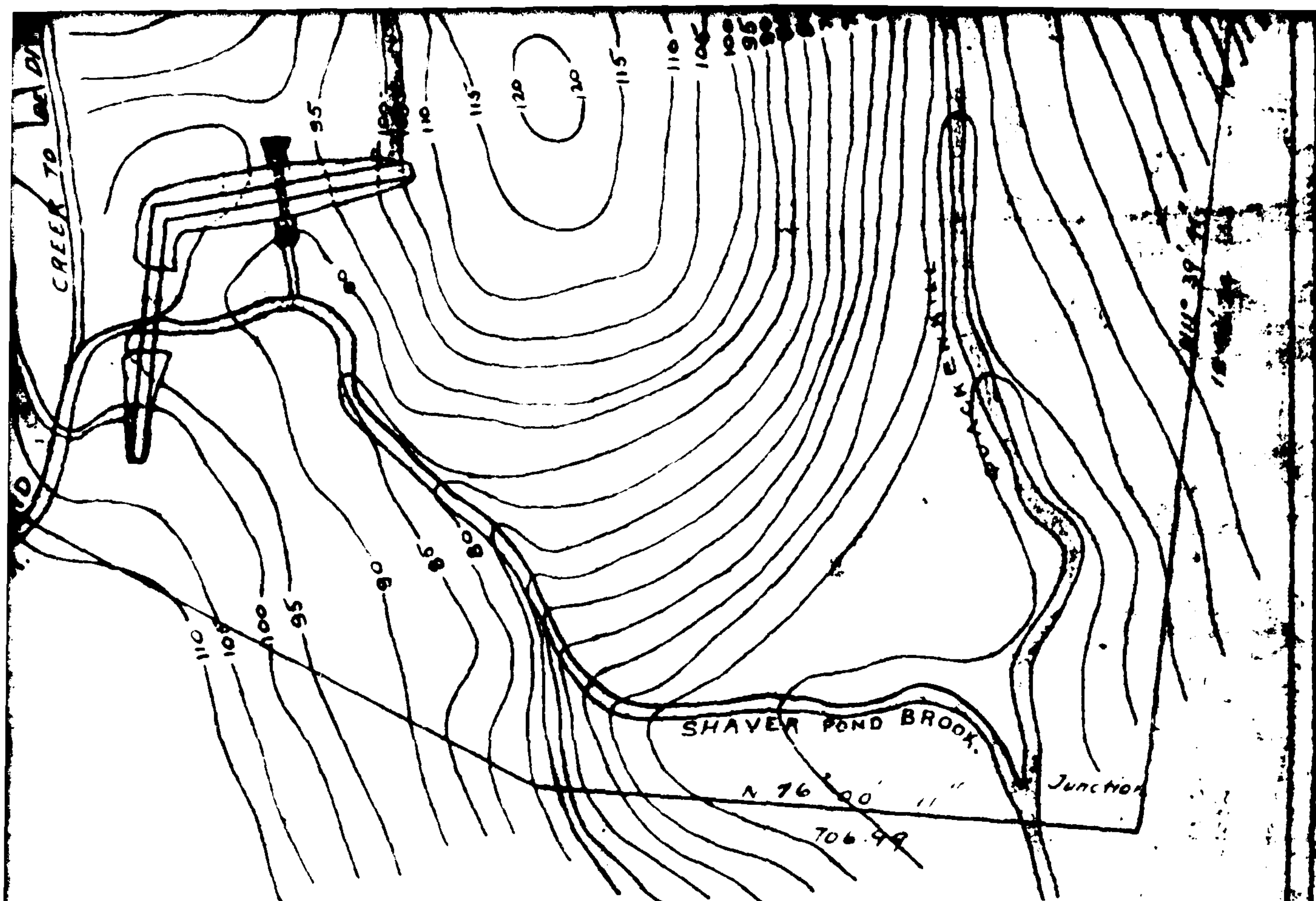
ROAD TO SAW MILL
ROAD
ROAD
MILL
SWA
100
105
110
115
120
125
130
135
140
145
150


ROAD TO SAW MILL
N 87°15'38"
209.23
591.70
506.58
374.20
89.68
1160.99
85
90
95
100
105
110
115
120
125
130



App

Com

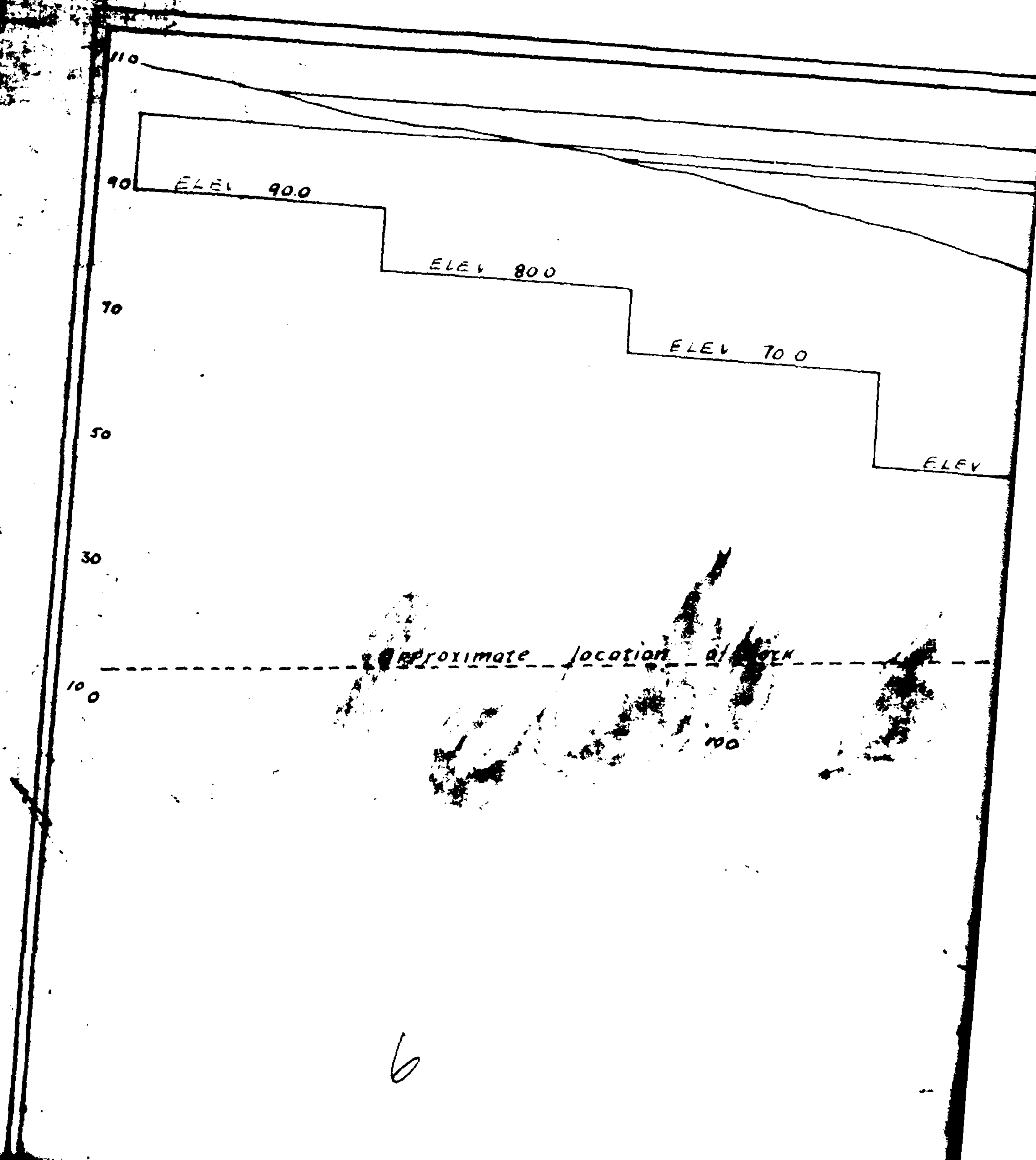


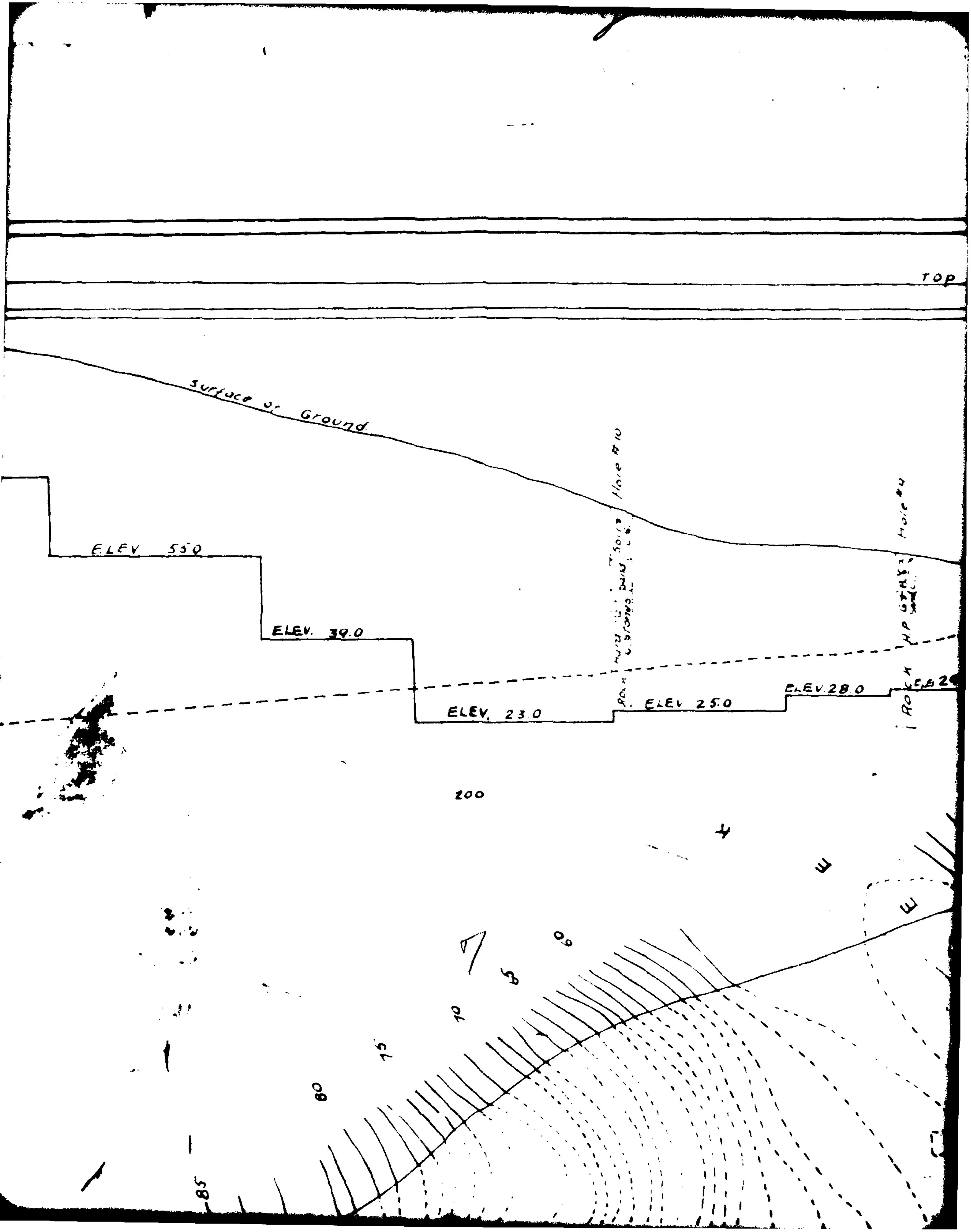
Approved, Feby 27 1911

W. H. Giess

Com'r. of Public Works,

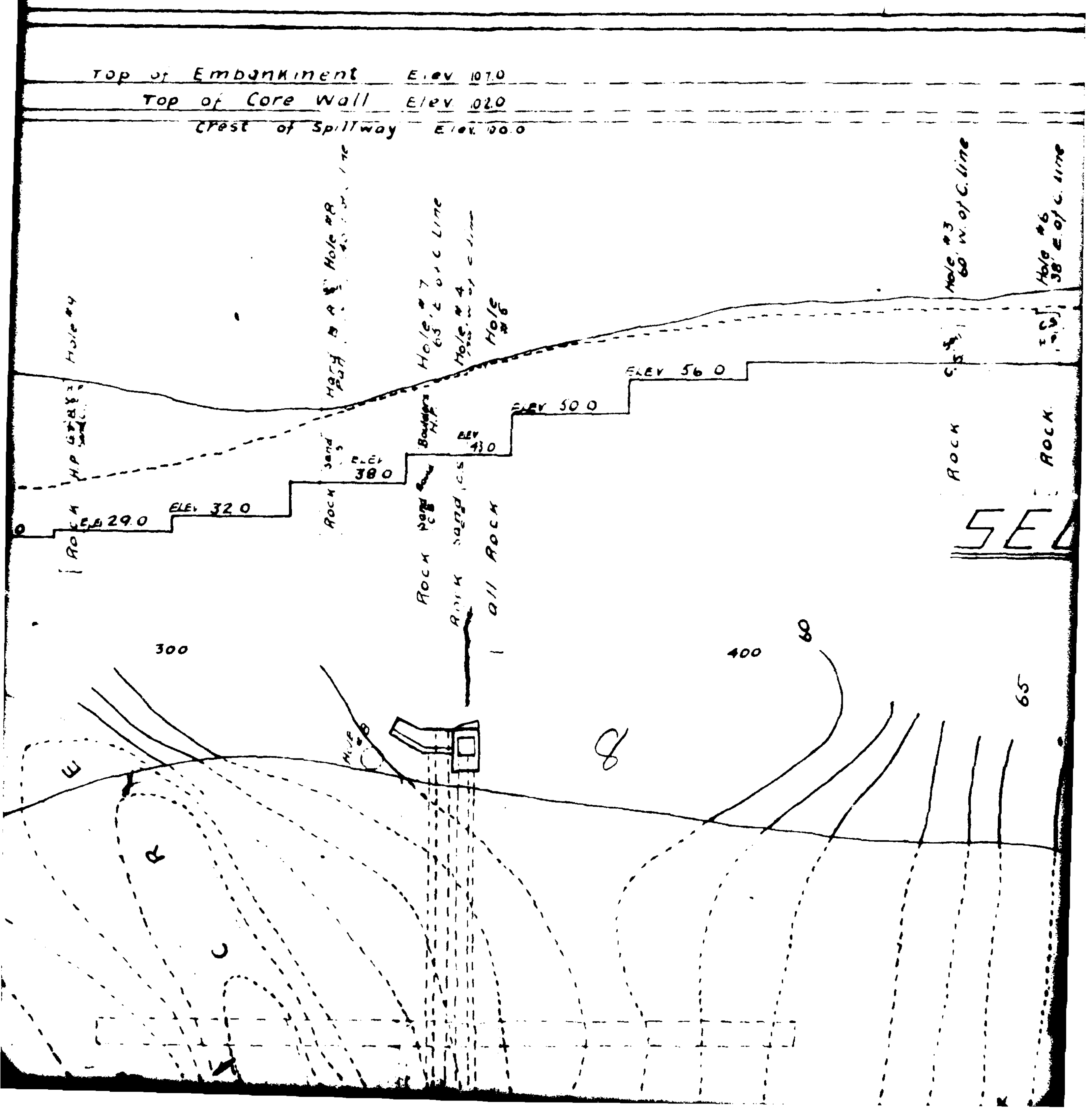
Troy, N.Y.


110
90
ELEV 90.0
ELEV 80.0
70
ELEV 70.0
50
ELEV
30
Approximate location of
10
0
100
6

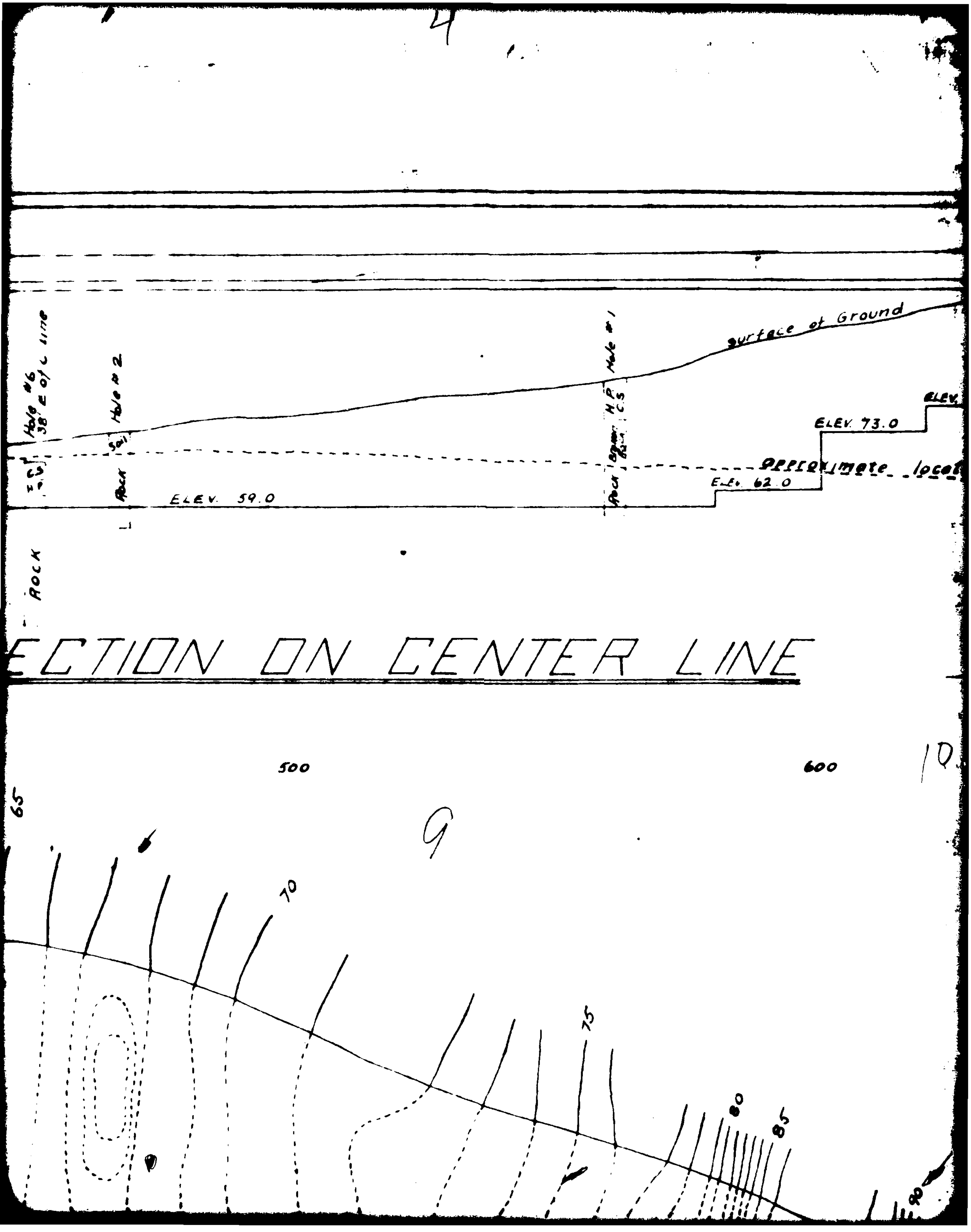


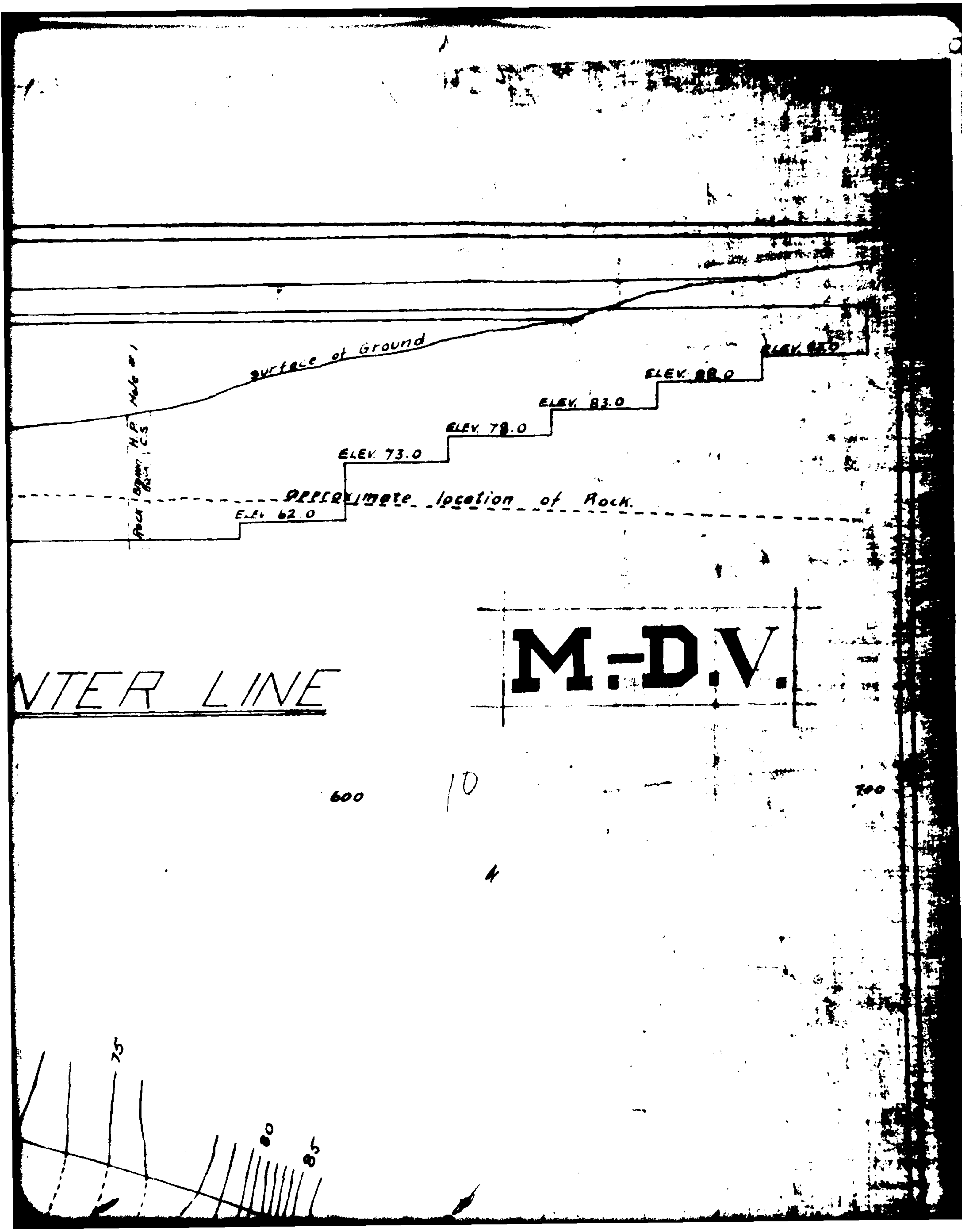
TOP
Surface of Ground
Hole #10
Hole #4
ELEV 55.0
ELEV. 39.0
ELEV. 23.0
ELEV 25.0
ELEV 28.0
ROCK
200
85
80
75
70

1 3

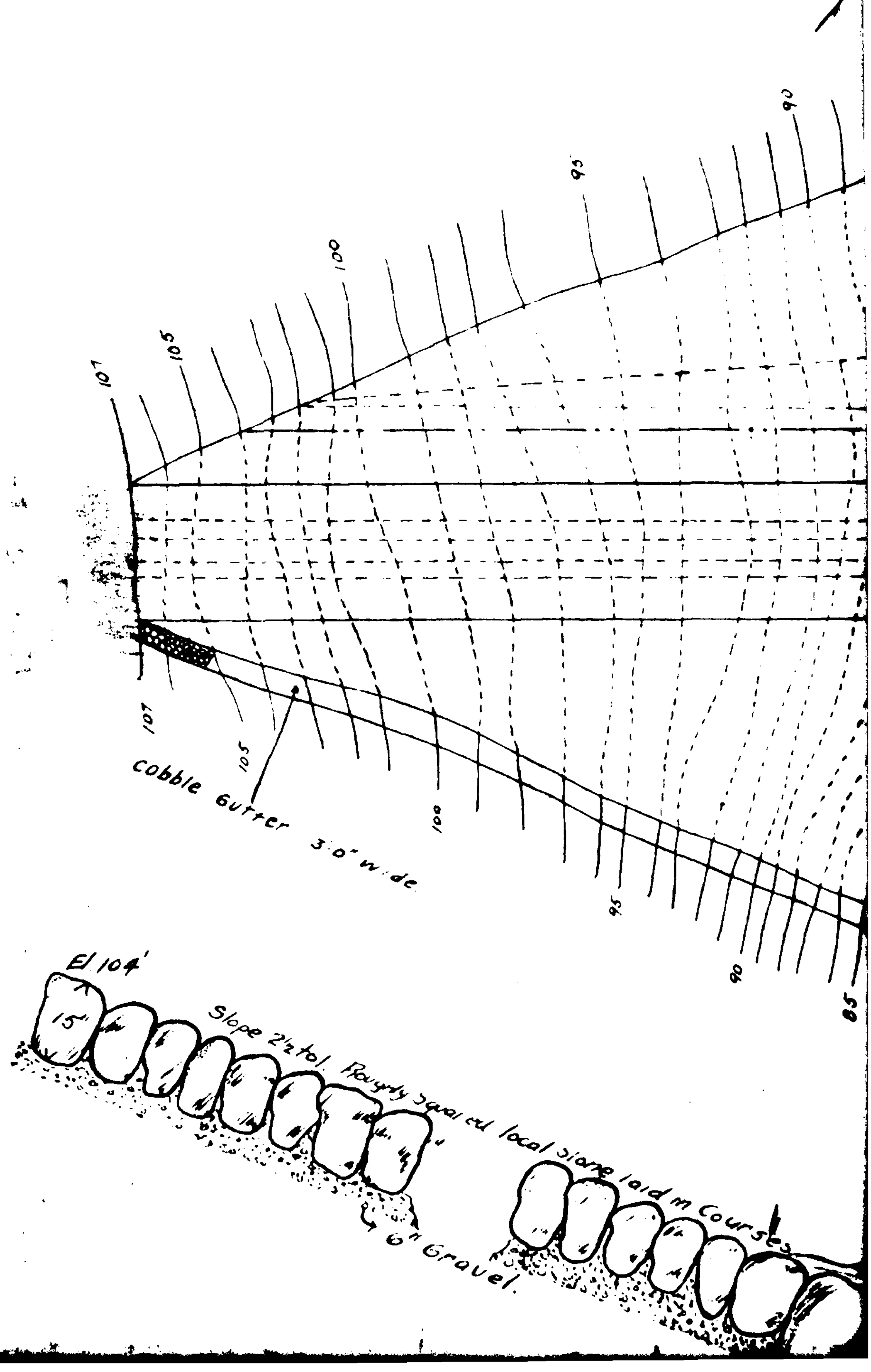


Top of Embankment Elev 107.0
Top of Core Wall Elev 102.0
Crest of Spillway Elev 100.0
Hole #4
Hole #7
Hole #4
Hole #6
Hole #3 60' W. of C. Line
Hole #6 38' E of C. Line
ELEV 56.0
ELEV 50.0
ELEV 43.0
ELEV 38.0
ELEV 32.0
ELEV 29.0
ROCK
ROCK
ROCK
ROCK
All ROCK
SE
300
400
60
65

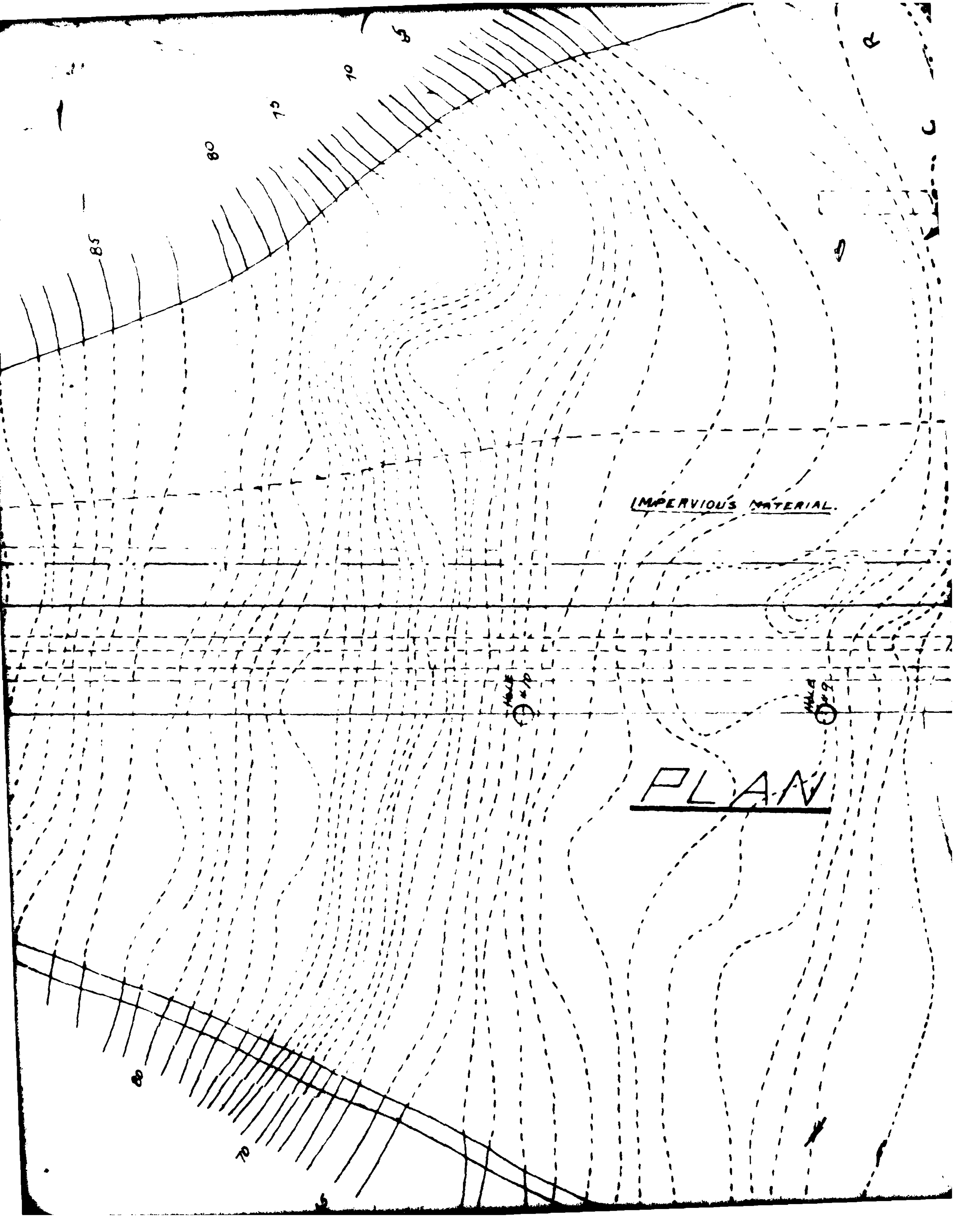

4
Hole #6 38' E of ℄ line
Hole # 2
Soil
Rock
Hole #1
H.P. C.S.
Rock
Surface of Ground
ELEV. 73.0
ELEV.
ELEV. 62.0
ELEV. 59.0
Approximate locat
ROCK
ECTION ON CENTER LINE
500
600
10
65
9
70
75
80
85
90


surface of Ground
Hole #1
ELEV. 62.0
ELEV. 73.0
ELEV. 78.0
ELEV. 83.0
ELEV. 88.0
Approximate location of Rock.
NTER LINE
M.-D.V.
600
10
700
75
80
85

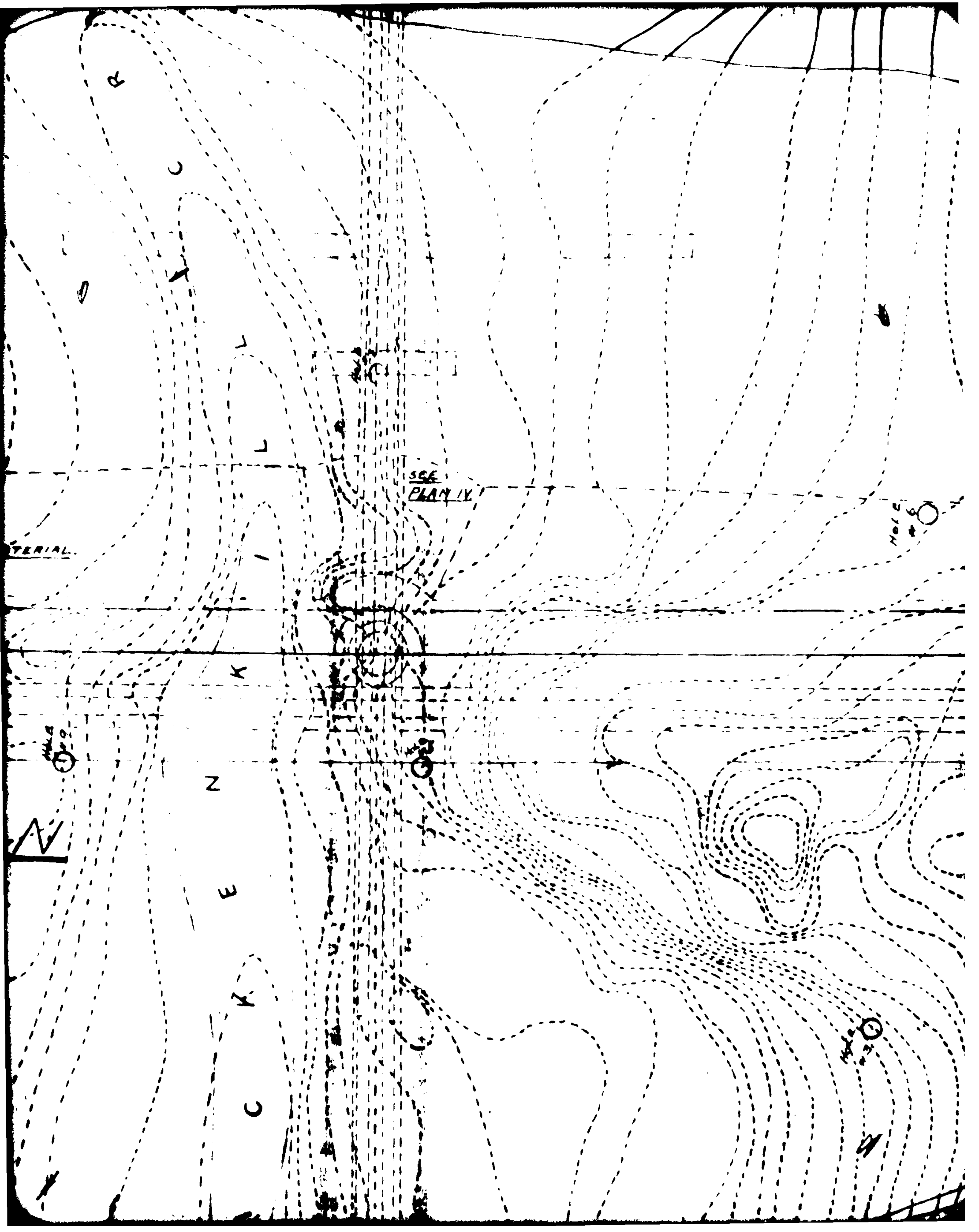
6



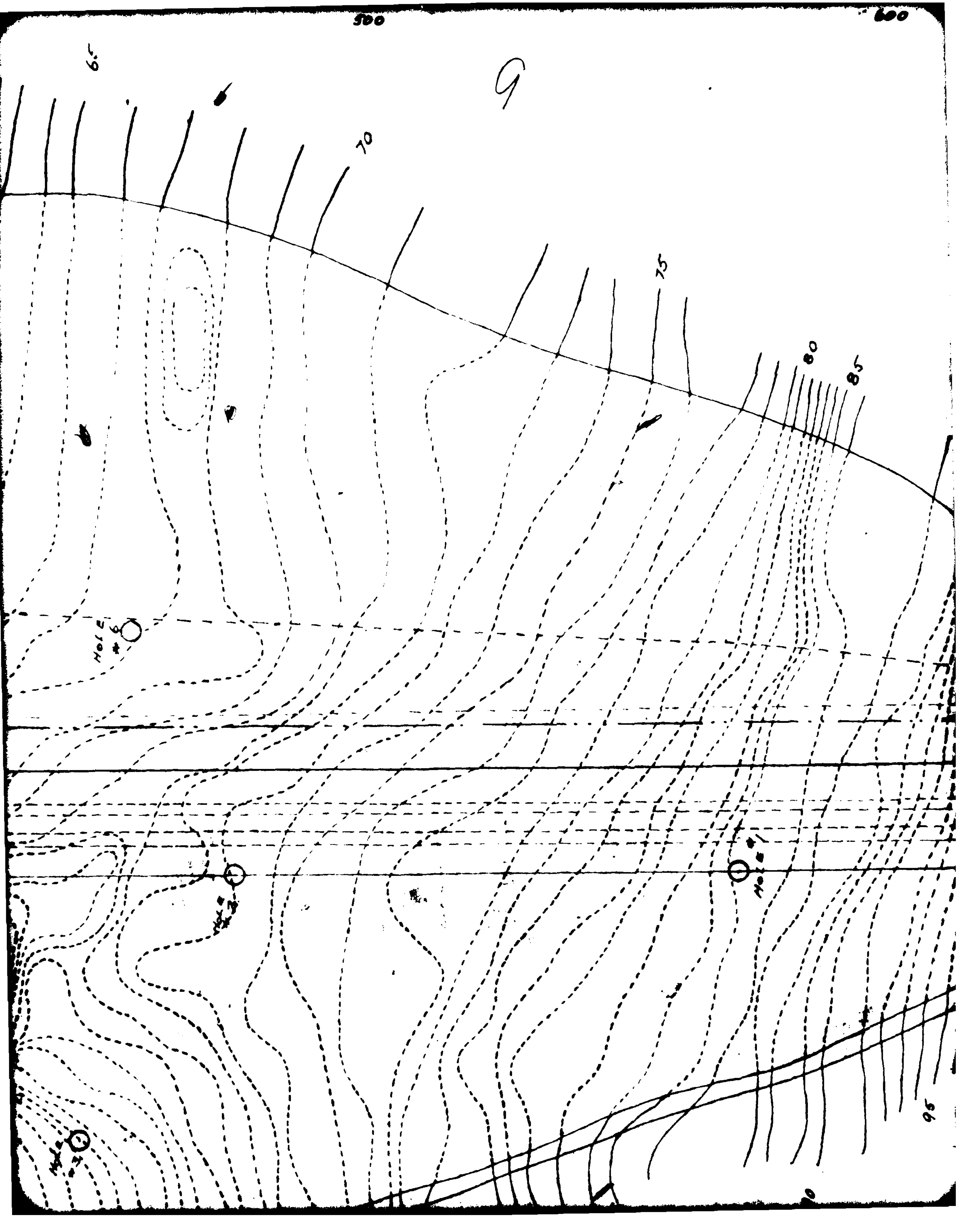
107
105
100
95
90
107
105
100
95
90
85
Cobble Gutter 3'0" wide
El 104'
15"
Slope 2½ to 1. Roughly squared local stone laid in courses
6" Gravel.

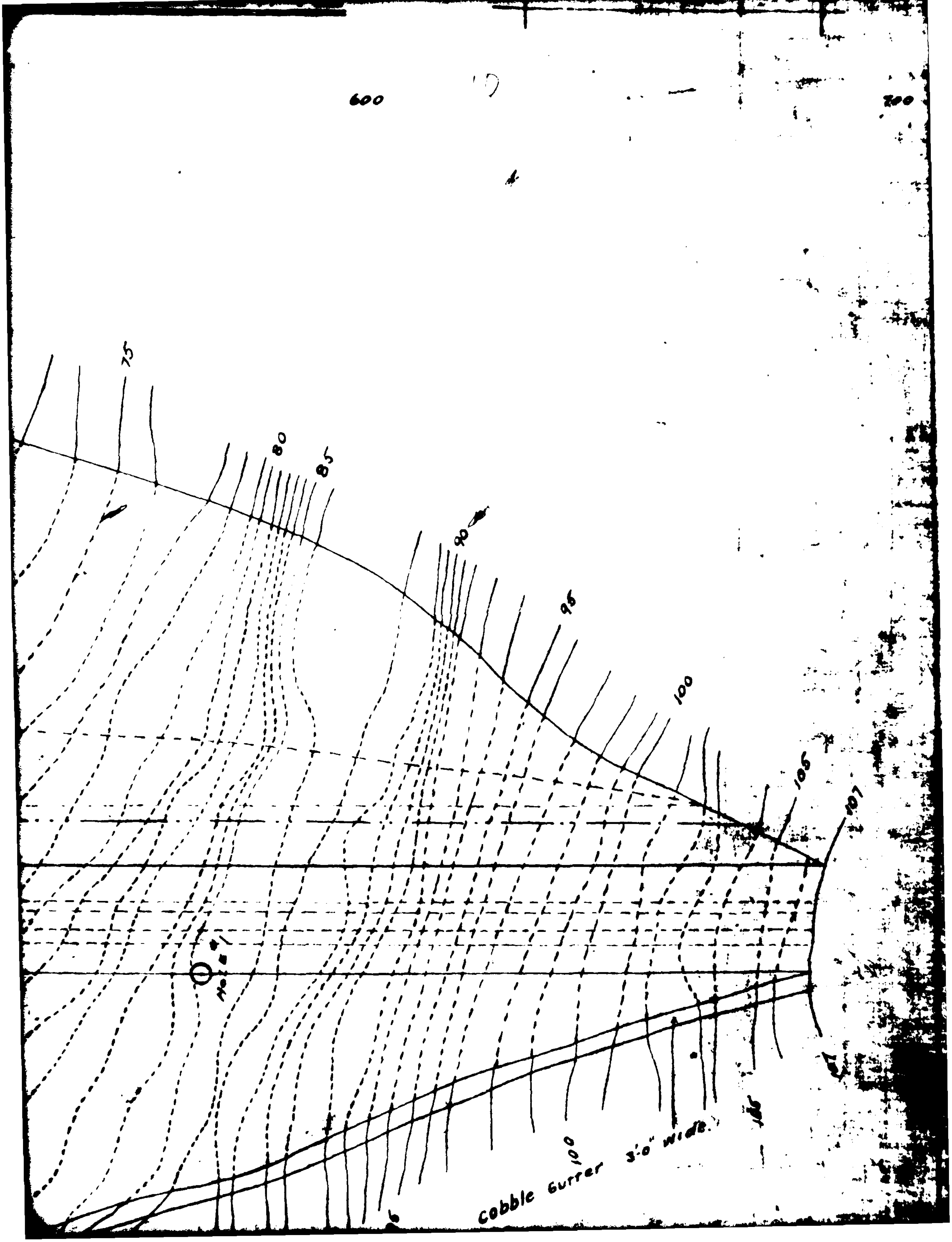


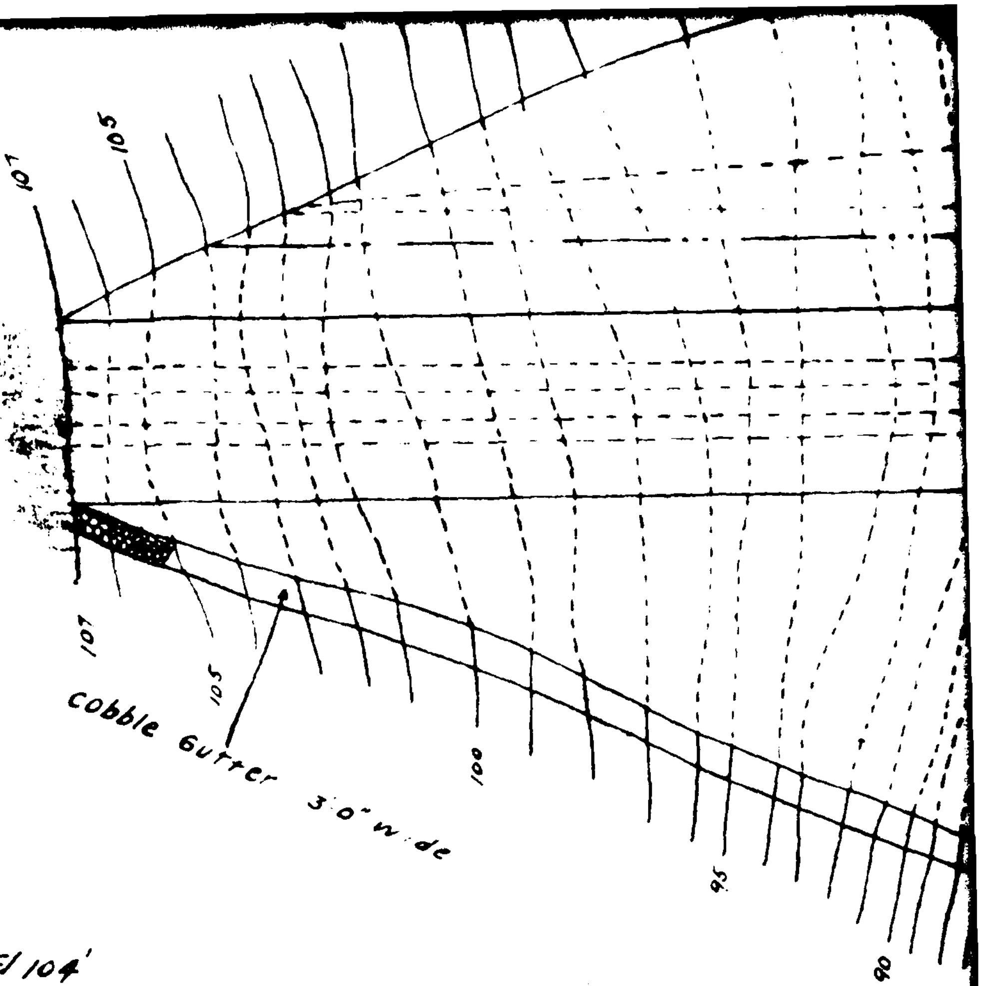
IMPERVIOUS MATERIAL.
PLAN
HOLE No 10
HOLE No 9
85
80
75
70
80
70

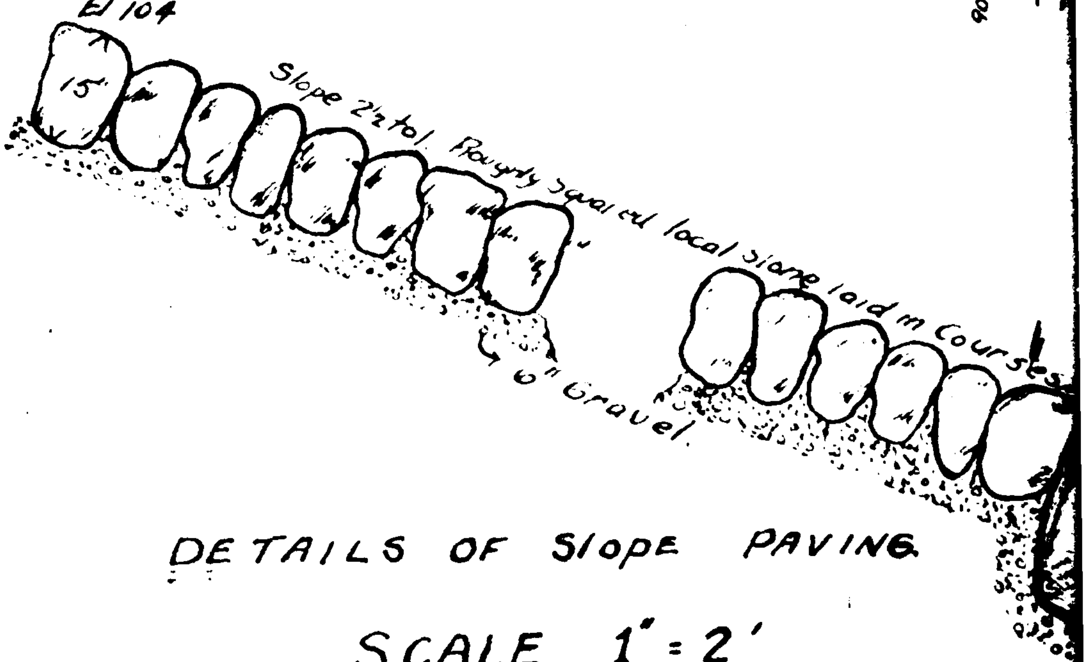


SEE
PLAN IV
TERIAL.
HOLE #6
HOLE #3


500
600
9
65
70
75
80
85
95
Hole #6
Hole #3
Hole #1

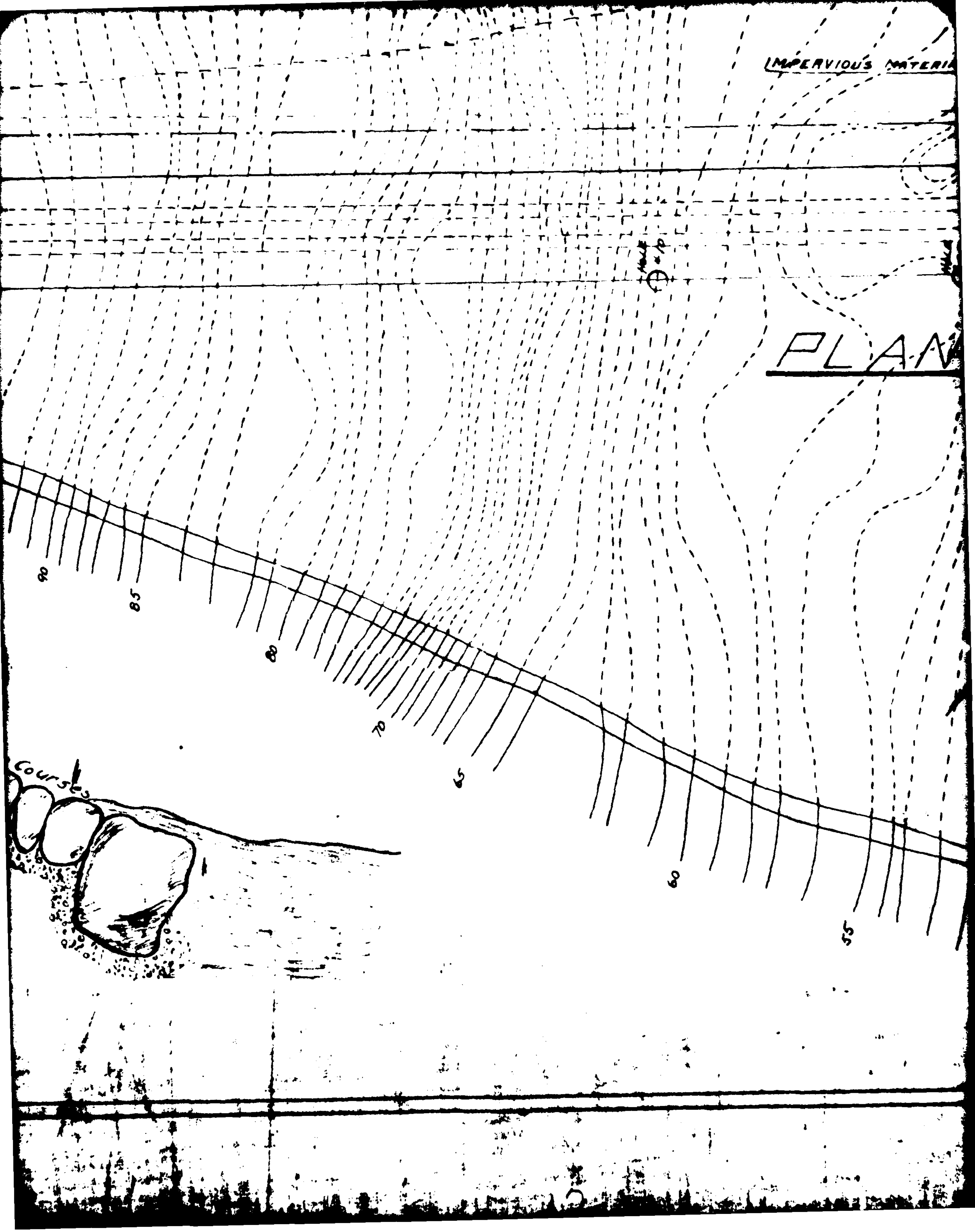

600
75
80
85
90
95
100
105
107
No. #1
100
Cobble Gutter 3'0" Wide.

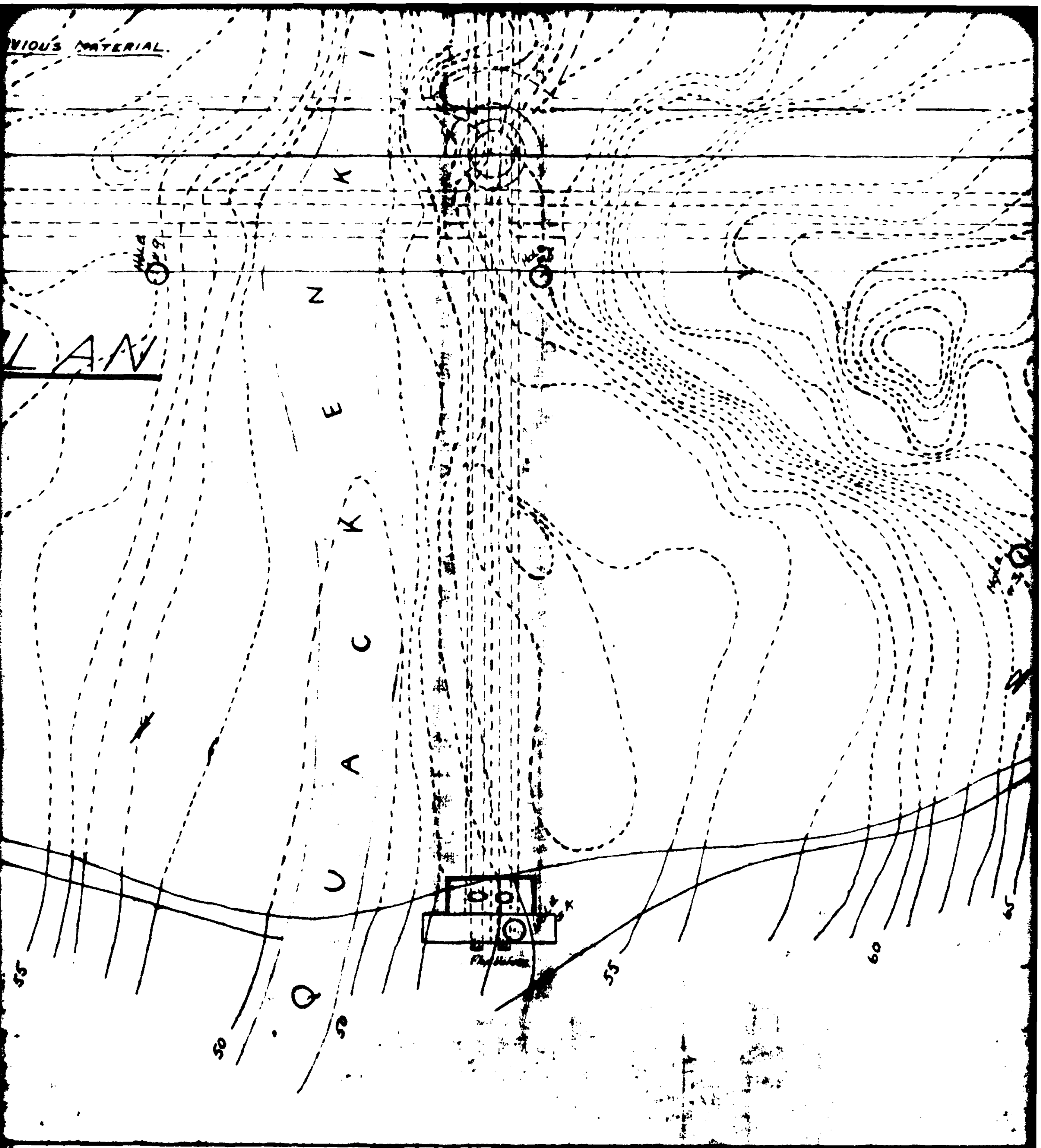


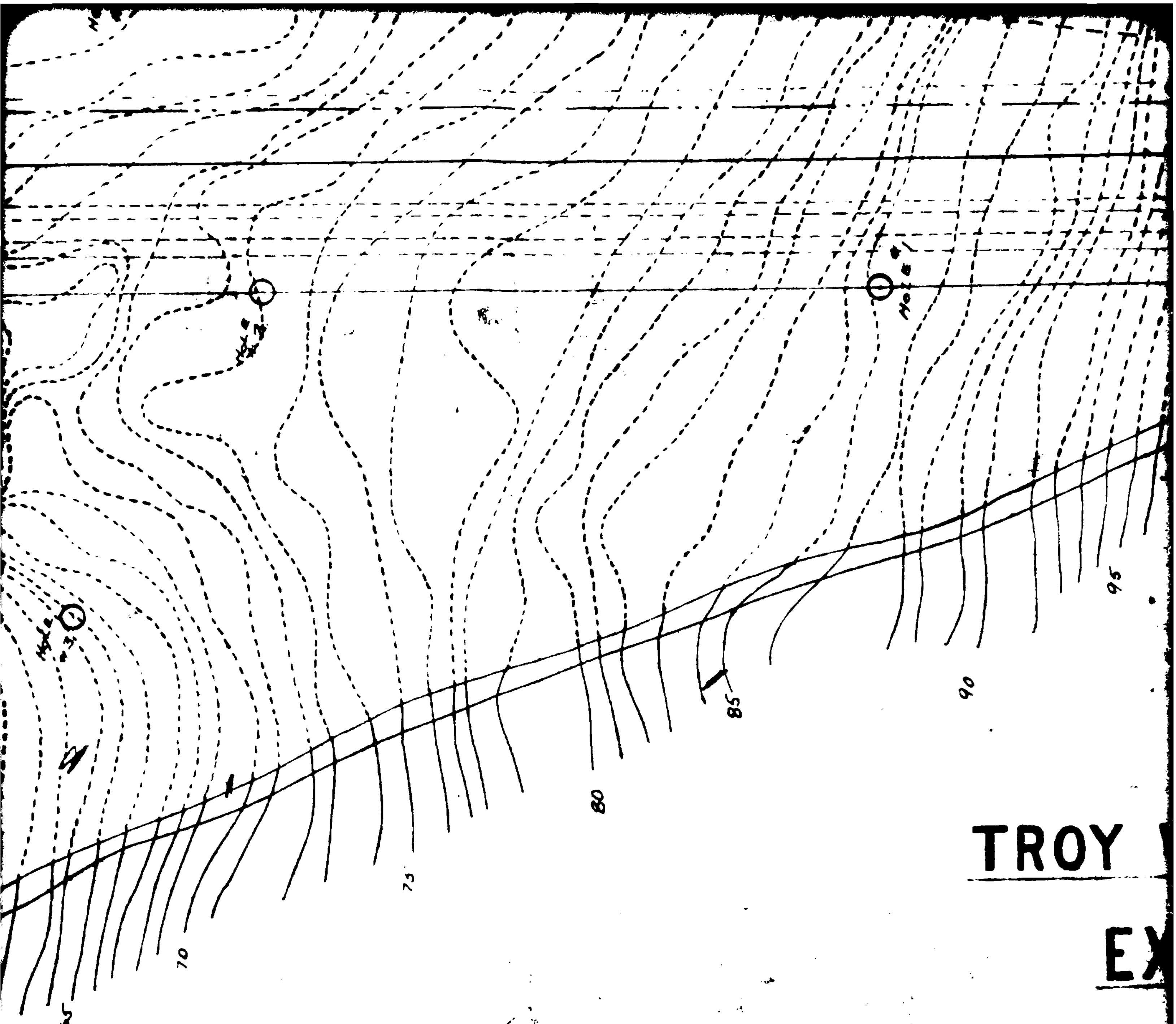


DETAILS OF SLOPE PAVING

SCALE 1" = 2'


IMPERVIOUS
90
85
80
70
65
60
55
Courses


VIOUS MATERIAL.
LAN
Q U A C K E N K
55
50
50
55
60
65



TROY

EX

DAM FO

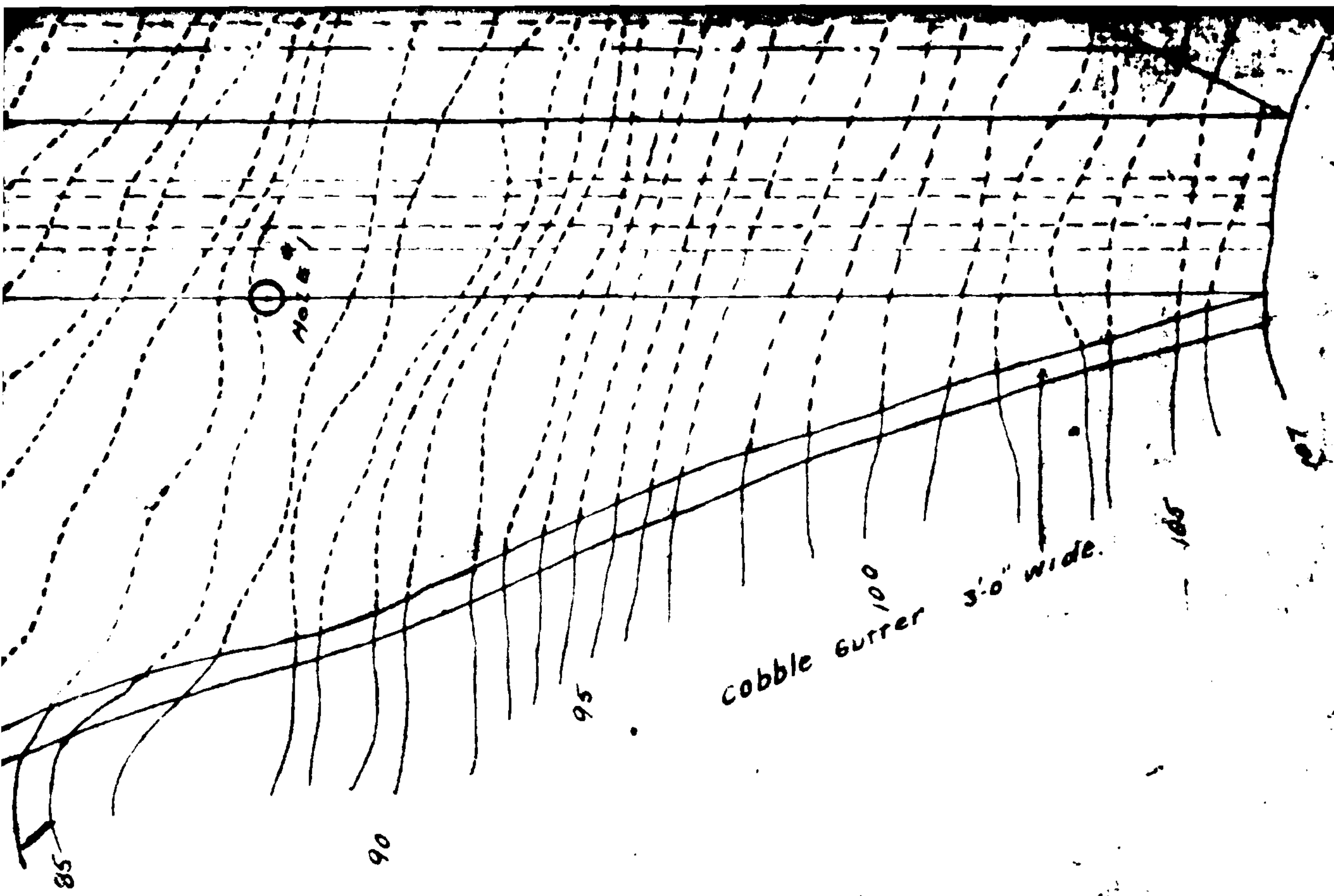
S

Approved, *Feb. 27. 1911*

W. H. Shields

Com'r. of Public Works,

Troy, N. Y.



TROY WATER WORKS EXTENSION

PLAN OF DAM FOR RESERVOIR

SCALE 1 INCH = 20 FT.

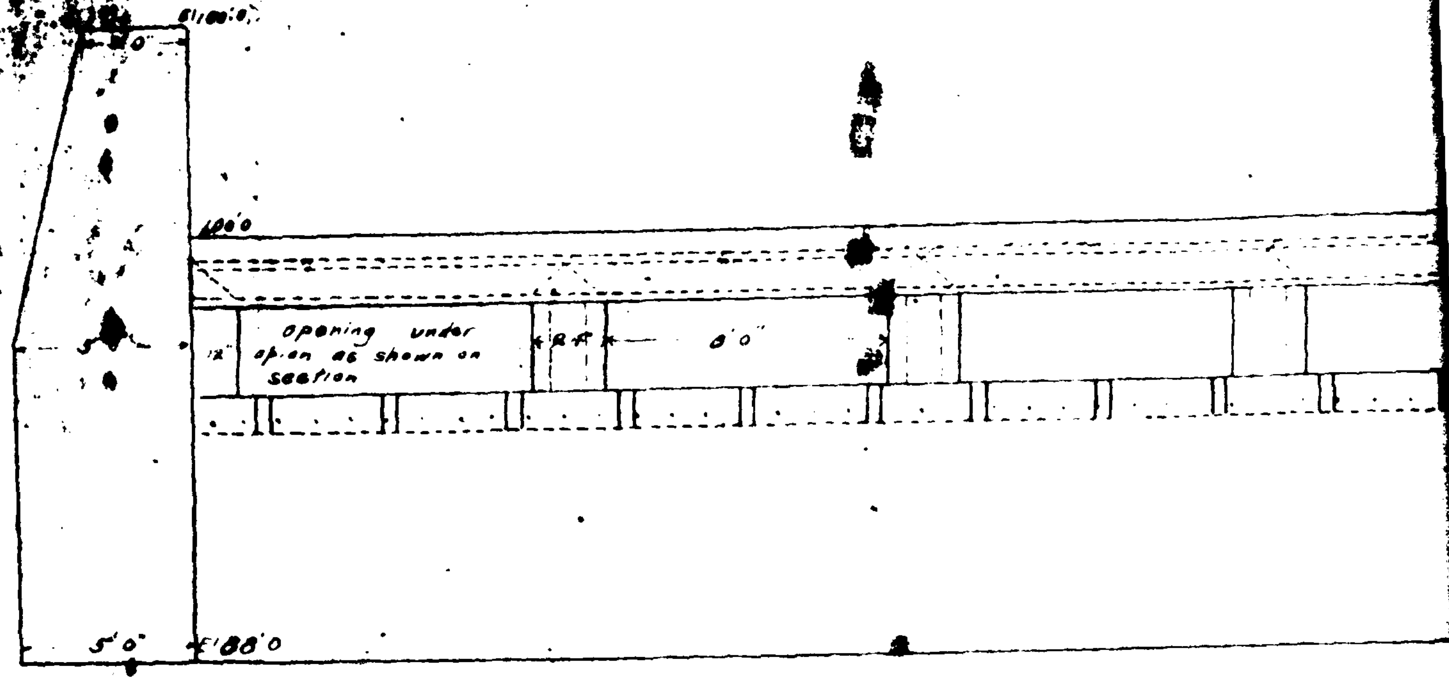
15

1911

Works,

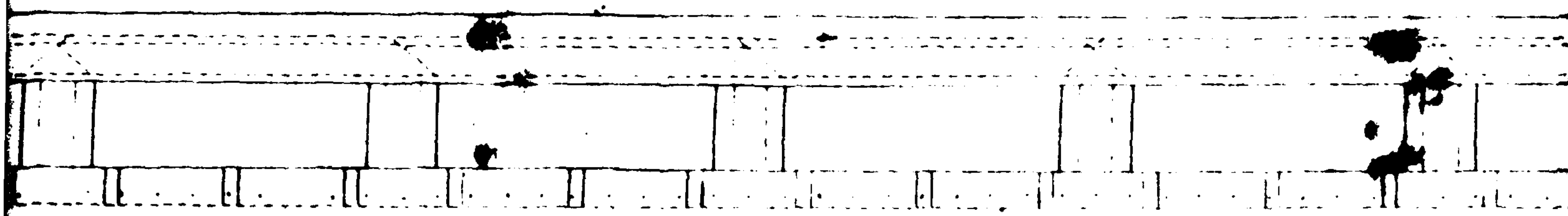
N.Y.

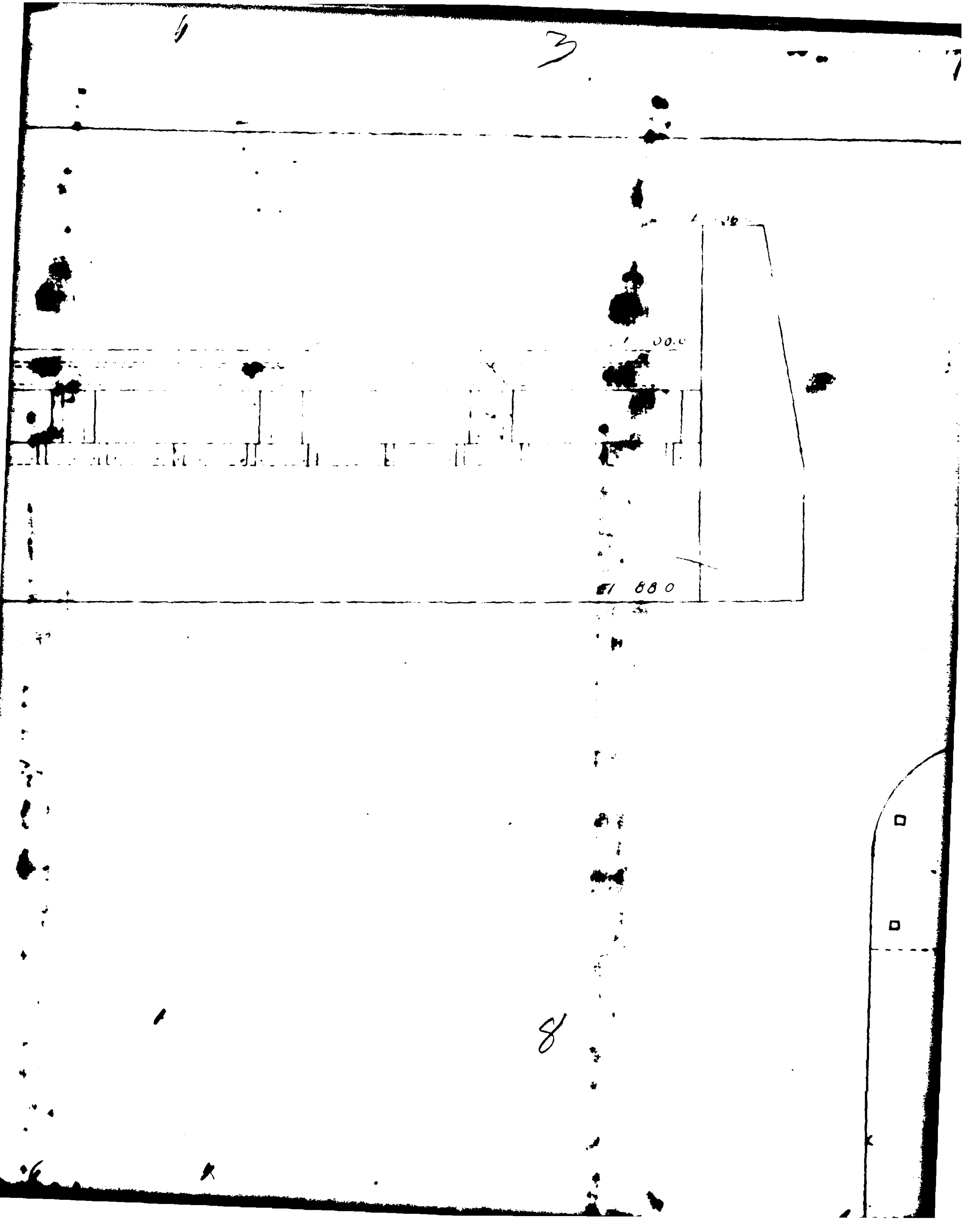
15

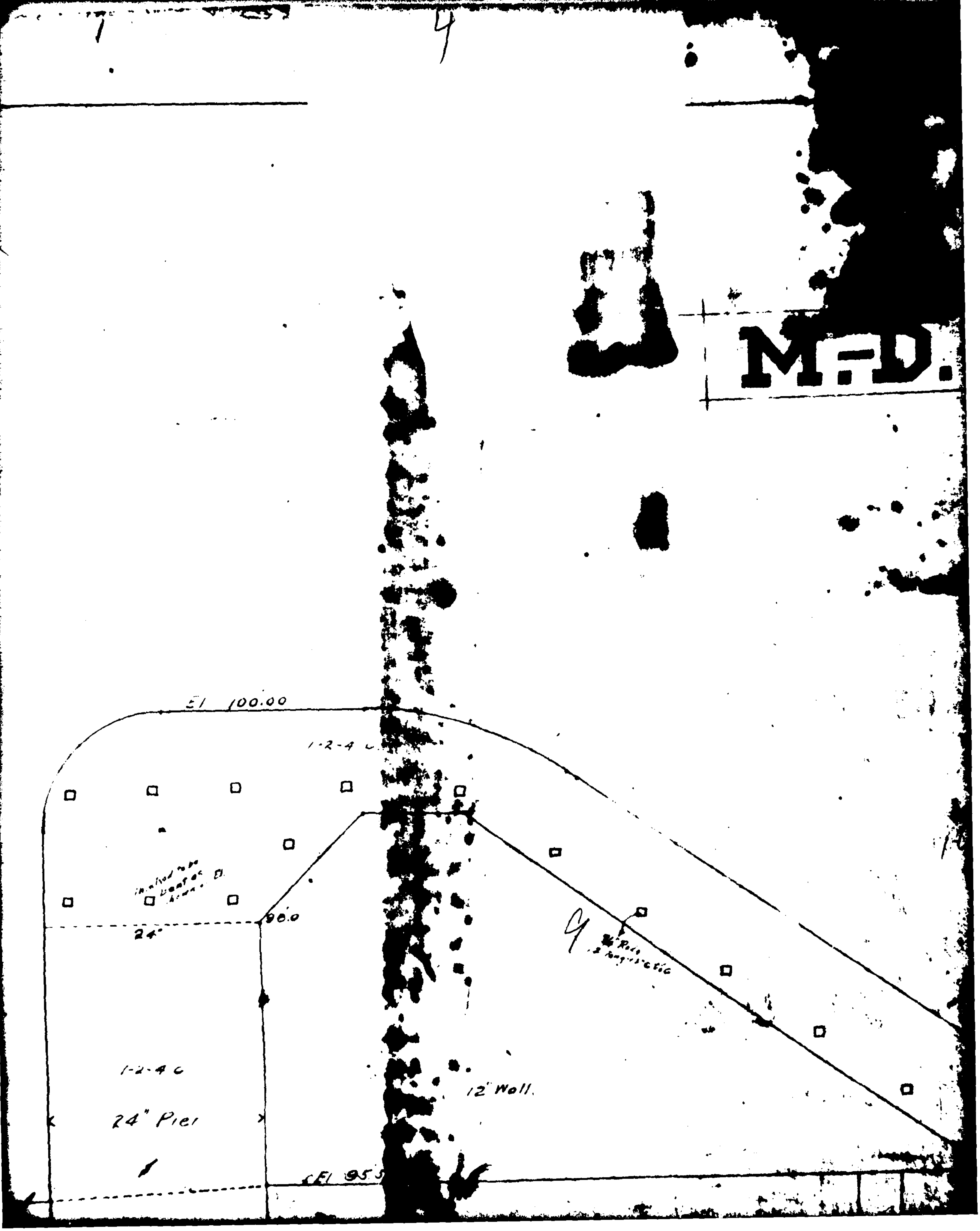


6

Elevation Scale 1 = 5

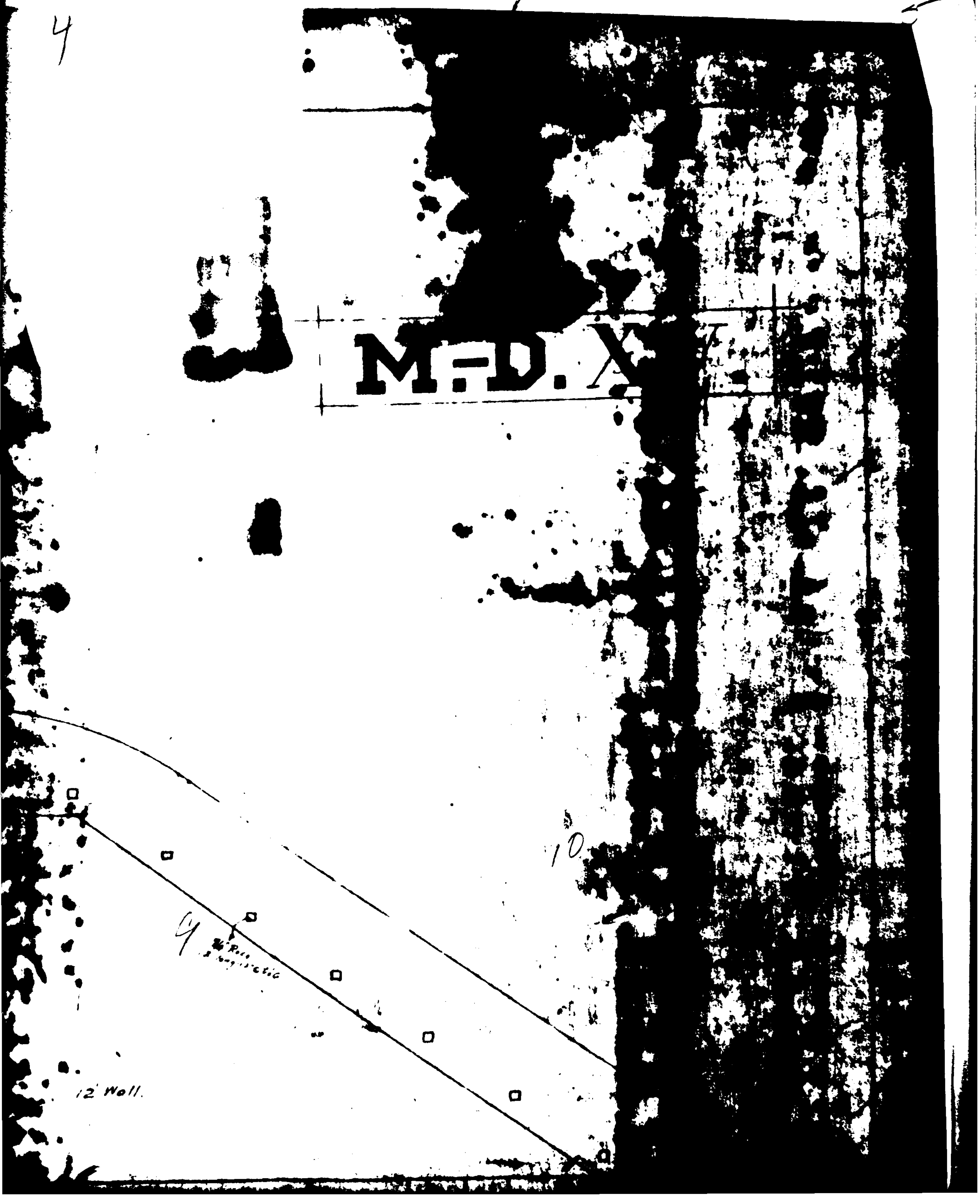


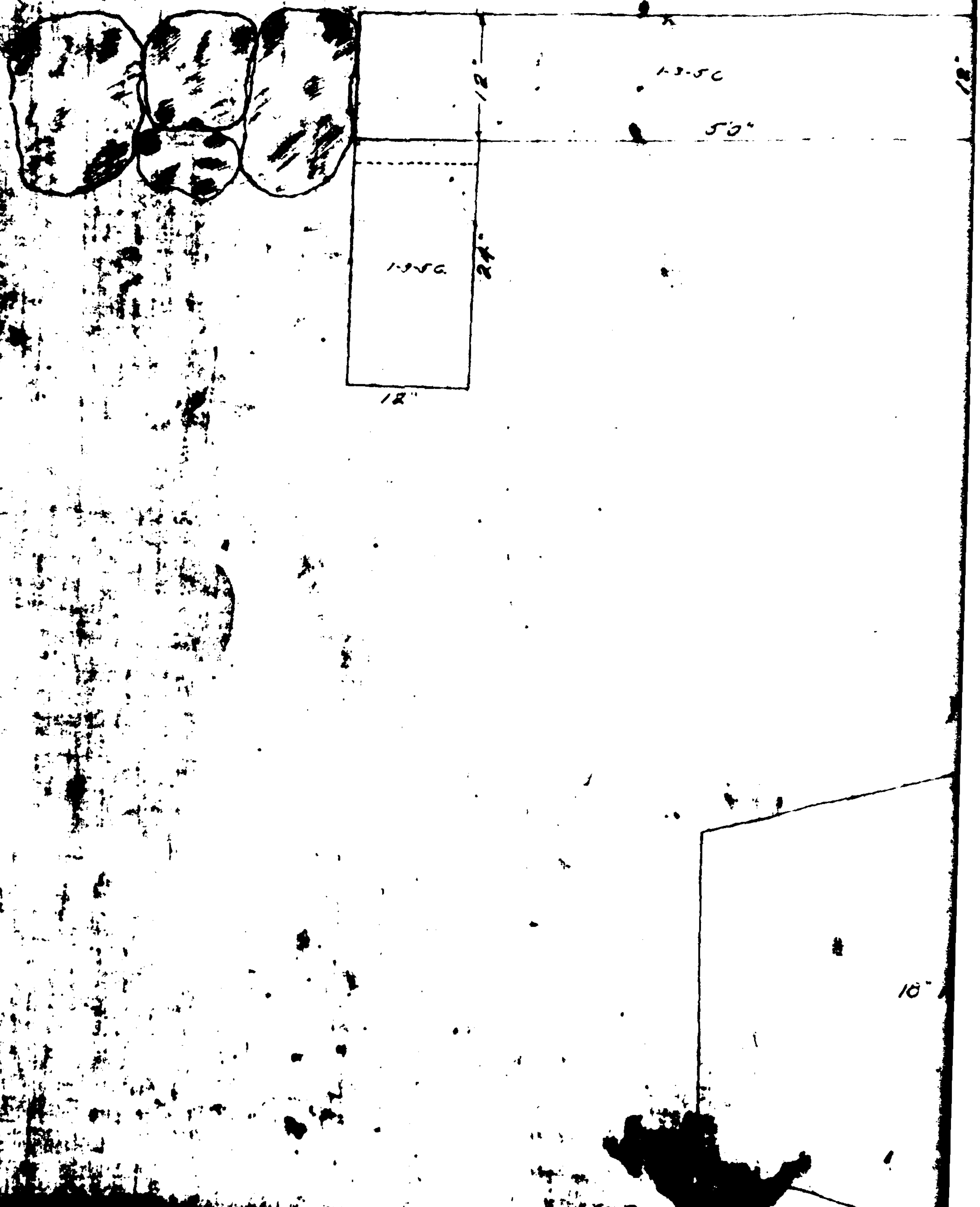

3
880
8

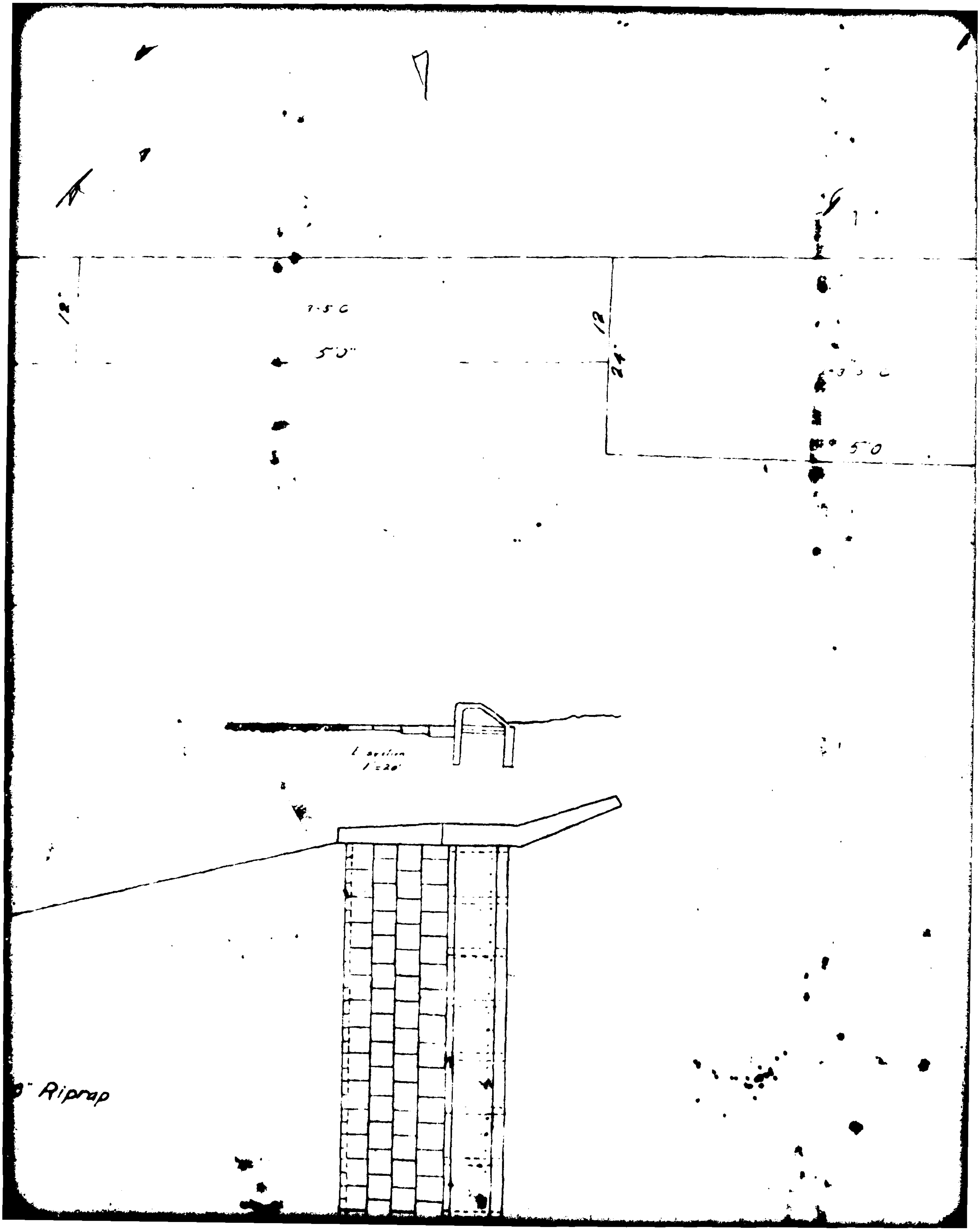


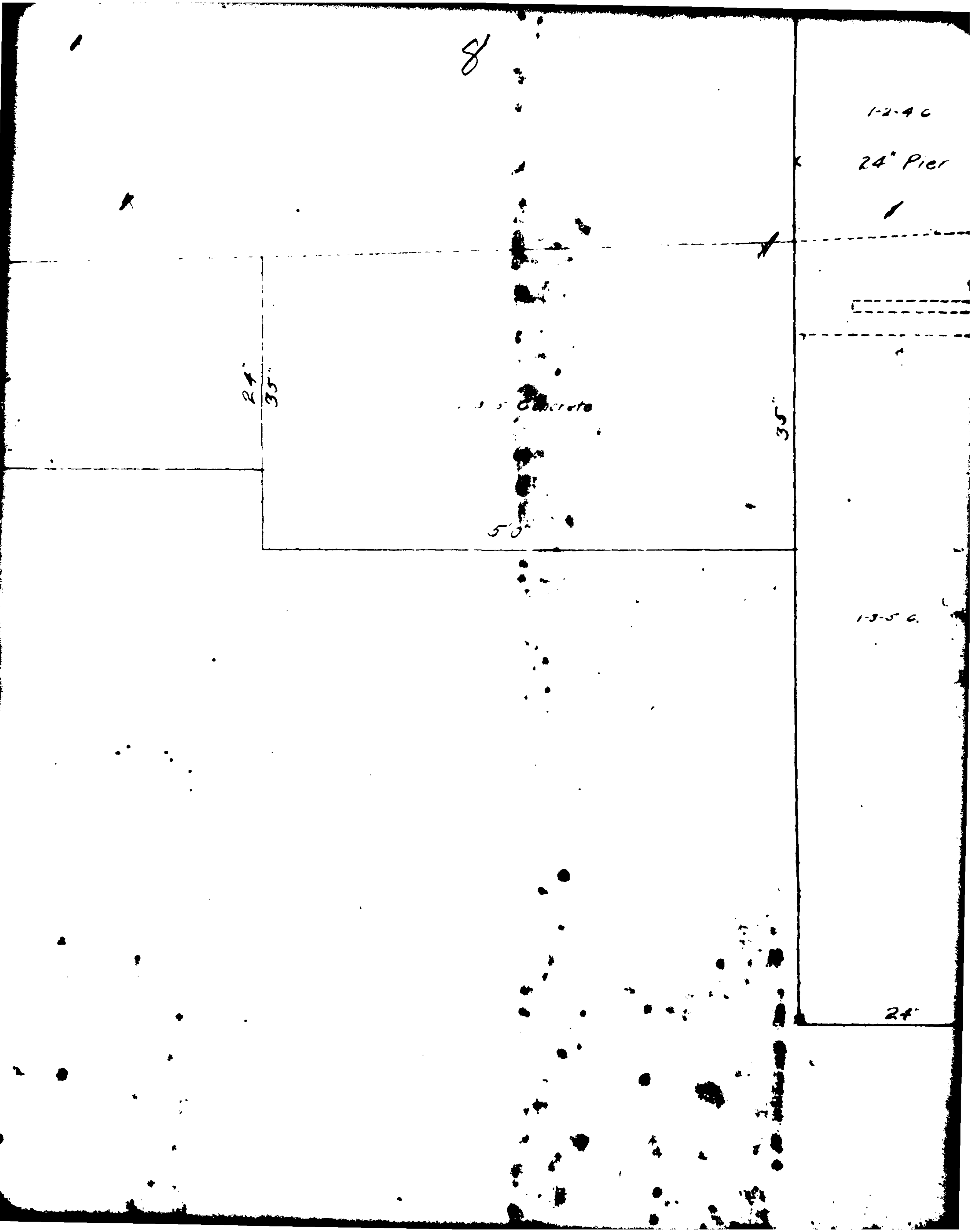
1
4
M.D.
El 100.00
1-2-4 C
96.0
24"
1-2-4 C
24" Pier
12" Wall
El 95.5

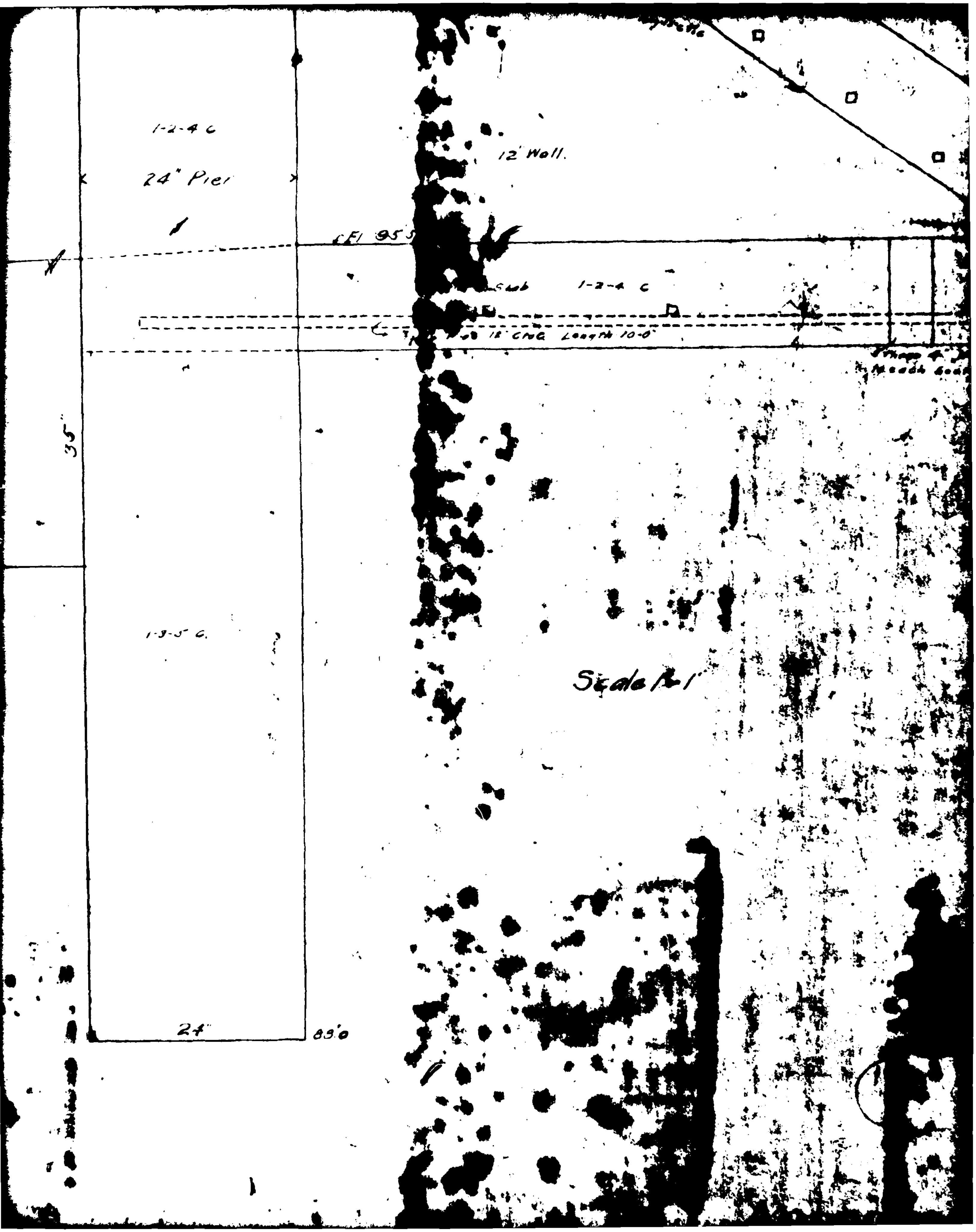
4

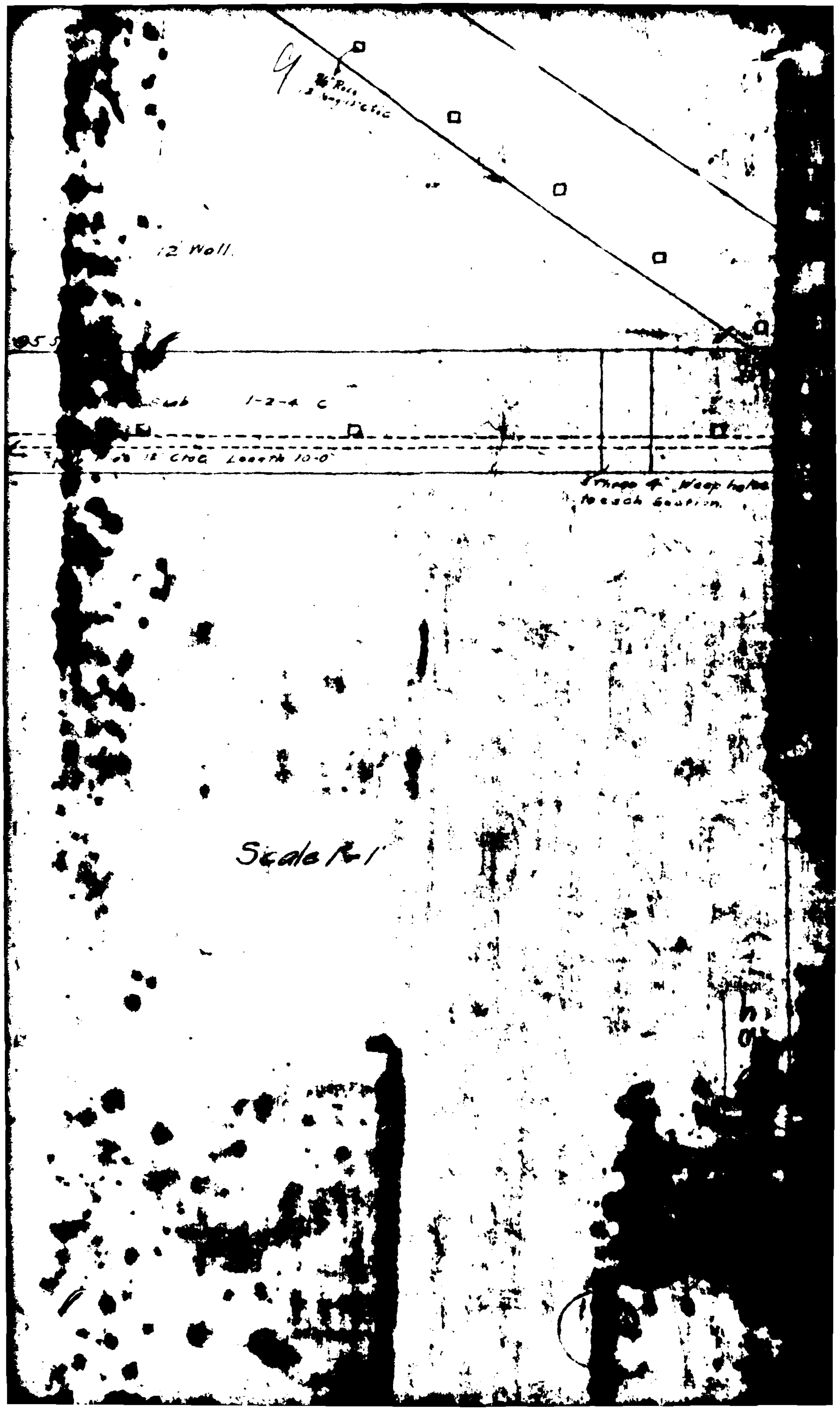


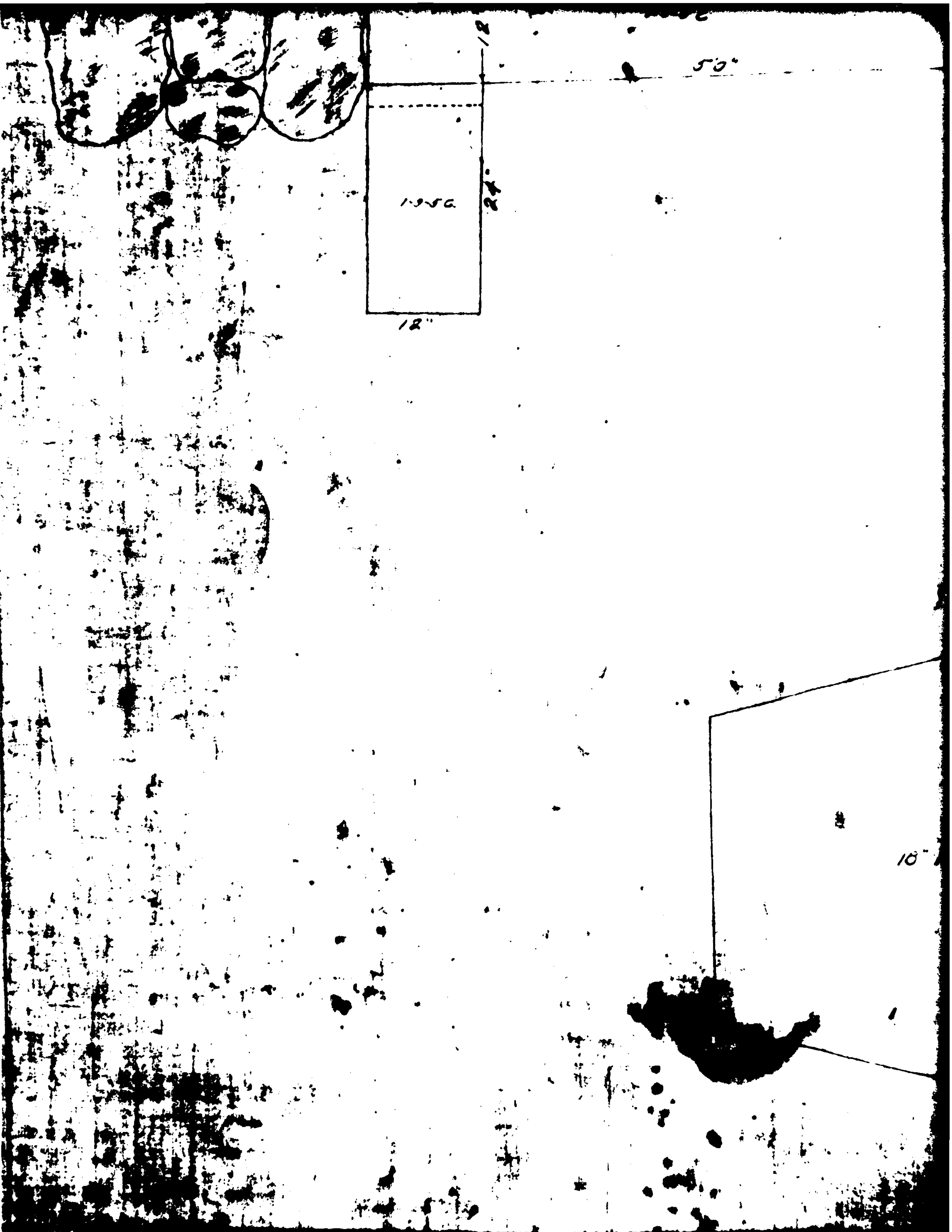

1-3-5C
12"
5'0"
1-3-5C
24"
12"
10"


5'0"
12
24'
5'0
Riprap

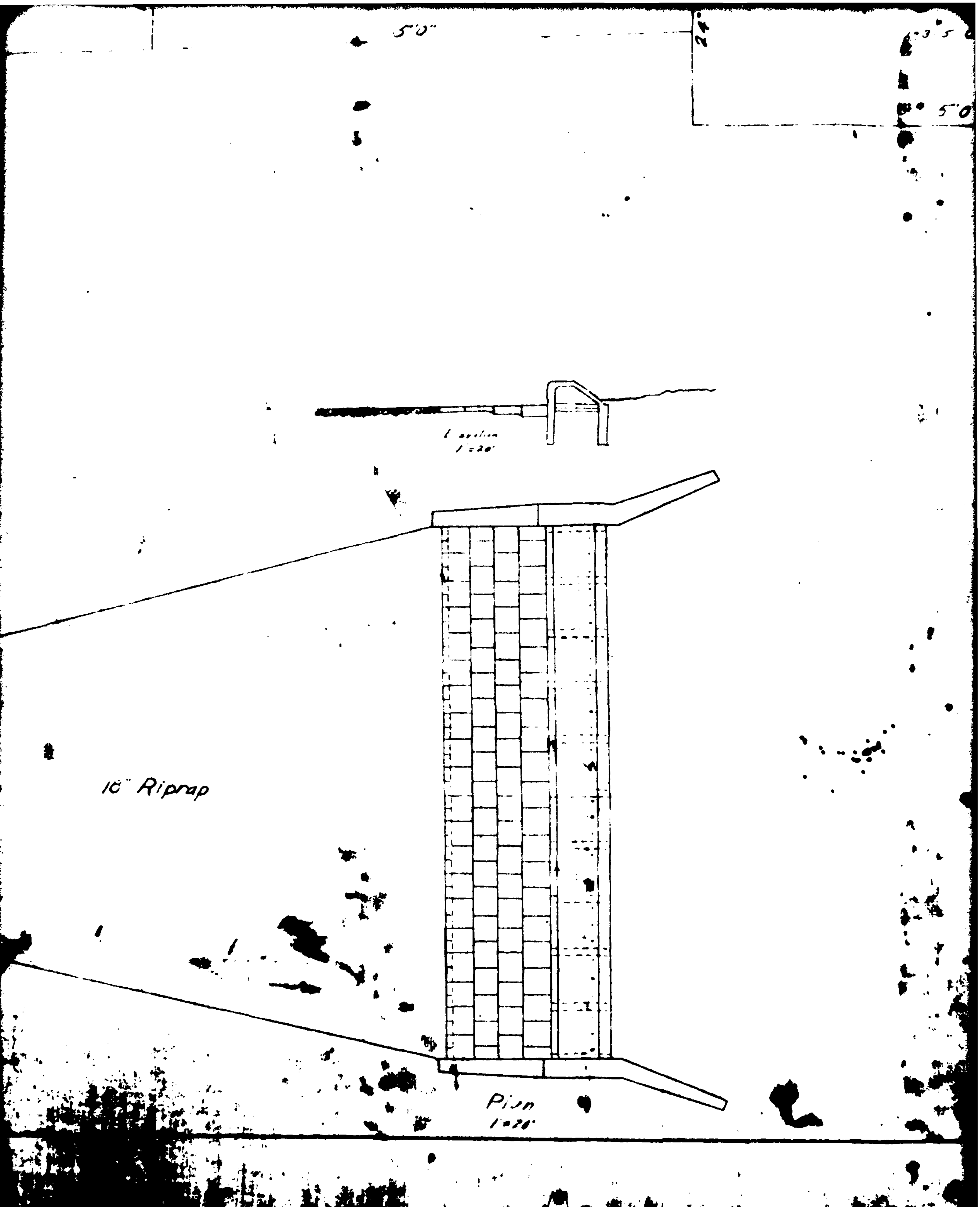

8
1-2-4 C
24" Pier
24"
35"
1-3-5 Concrete
5'0"
35"
1-3-5 C.
24"


1-2-4 C
24" Pier
12' Wall
Slab 1-2-4 C
35'
1-3-5 C.
24"
83.0

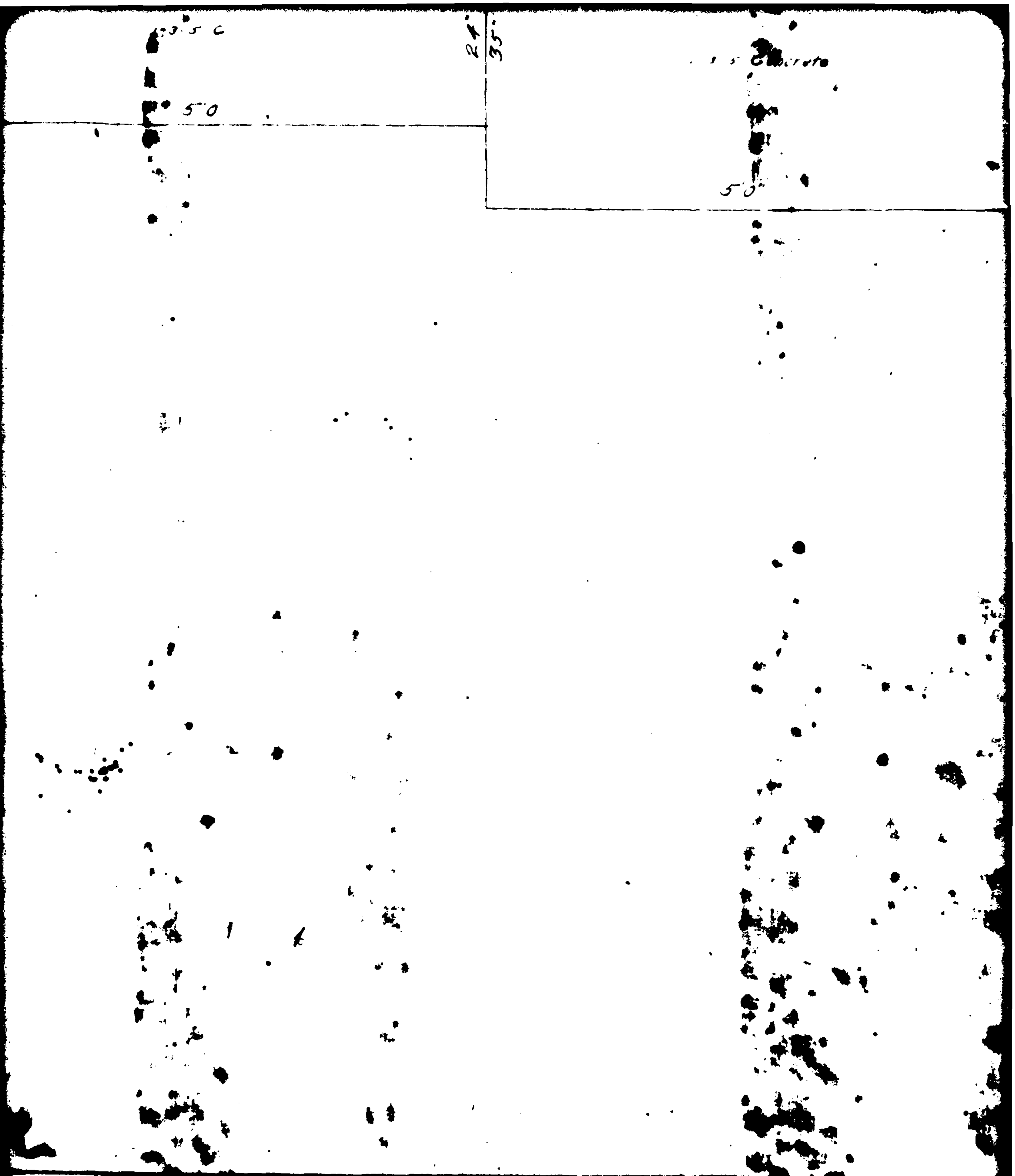

12" Wall
Slab 1-2-4 C
Length 10-0"
4" Weep hole
to each Section.
Scale



5'0"
12"
10"



5'0"
5'0"
10" Riprap
Plan
1"=20'


3.5 C
5.0
24
35
5.0

35

24

88'0

Scale 1=1'

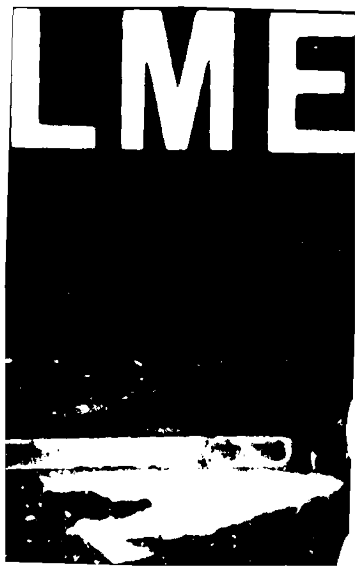
Approved

Com'r.

Scale ½=1'

Approved.

Com'r.


LME